

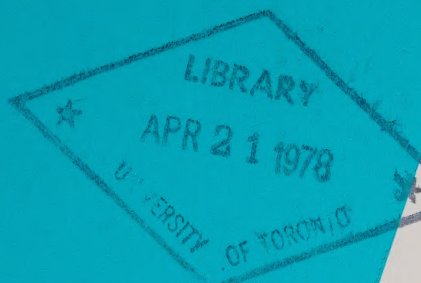
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Energy, Mines and
Resources Canada

Energie, Mines et
Ressources Canada

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INTRODUCTION

The world continued to feel the impact of high oil prices in 1977. Each barrel of oil Canada imported in 1977, for example, cost almost six times as much as a barrel imported in 1970. The effects were particularly dramatic in the United States. Oil imports severely disrupted the United States balance of payments and contributed to the decline of confidence in the U.S. dollar. President Carter repeatedly emphasized the importance of energy stability as a basis for renewed and continuing economic growth in the world's leading industrial economy.

While the growth in Canada's dependence on foreign oil is less dramatic than that of the United States, it is still a reality. This country, too, has been moving to greater dependence on the Middle East and other international sources as western Canadian supplies of conventional crude oil have continued to decline. If Canada is to avoid a sharp increase in imports, and soaring import costs, the nation must intensify the search for new conventional oil fields and assume the heavy costs of opening up the difficult oil sands deposits. Exploration for new conventional deposits has, in fact, been stepped up and in the latter part of 1977 there were signs of encouraging results in Alberta. In 1978, output from the oil sands will jump considerably when production starts at the federally supported Syncrude plant near Ft. McMurray.

Simultaneously, increased attention must be given to energy forms, which, though little used now, will become steadily more necessary as oil declines. Recognizing this, the federal government is devoting an increasing share of energy research and development funds to renewable energy forms.

Amid broad international concern about energy trade, a series of strong measures to avoid a future crisis were advocated by the International Energy Agency at a meeting held under the chairmanship of Canada, represented by Energy Minister Alastair Gillespie. The IEA has concluded that, "as early as the 1980s the world will not have sufficient oil and other forms of energy available." Oil-importing nations, including Canada, committed themselves to hold down their demands for imported oil.

The Canadian target is to limit imports of oil to one third of oil requirements by 1985, or 800 000 barrels a day, whichever is less. Since early 1976, when the federal government published *An Energy Strategy for Canada*, this country has in fact been committed to limiting 1985 imports to one third of requirements. The IEA declaration indicated anew the importance of this policy goal.

The *Energy Update* is an attempt to convey some recent information about the changing energy situation, using the *Energy Strategy* as a basic reference point.

Since gasoline and heating oil are readily available today, the casual observer may not see any reason for concern about a continuing flow of oil

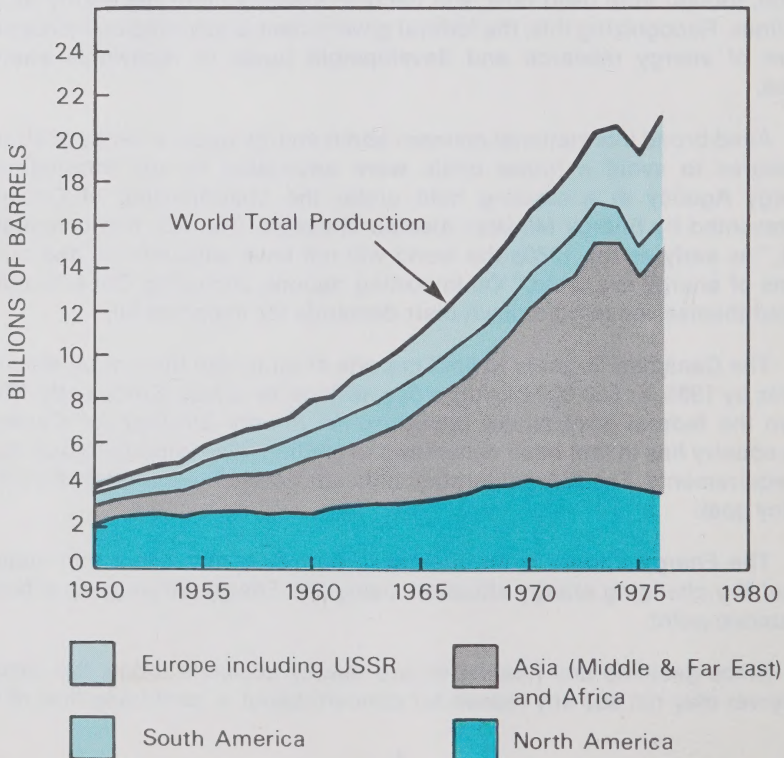
in the years to come. Two things need to be strongly emphasized. Even at a comparatively low rate of growth in energy demand, very large new sources of supply are needed to satisfy the world's already enormous appetite for oil and to offset declining oil regions. It is indeed worrying, then, to consider that additions to proven reserves from the discoveries of the past 15 years — in North Africa, West Africa, the North Sea and the North Slope — would fill the world's **present requirements for only six years.**

The second, equally important, point is that the world will increasingly be competing for the major remaining Middle Eastern source — the oil reserves of Saudi Arabia. To cover all requirements, this one nation might be asked to expand greatly its already large daily oil production. It simply might not be possible, for either political or geological reasons, to get enough oil from this one source.

International and Canadian forecasts show clear signs of trouble occurring in the mid to late 1980s, which is really the day after tomorrow in energy planning terms.

At present, Saudi Arabia is maintaining production at 8.5 million barrels each day — and this small kingdom continues to experience large balance-of-payments surpluses amid the political instability of the Middle East. A political cut-off of oil supplies is always a possibility.

WORLD CRUDE OIL PRODUCTION



The pressure on Saudi Arabia would become extreme in the 1980s, when world production capacity begins to lag sharply below increasing demand. To illustrate the scope of the problem, the Canadian government has estimated 1990 world oil demand assuming low (3.5 per cent), medium (4.0) and high (4.5) rates of growth in energy use by the non-communist nations. These growth rates are all well below the 1963-73 average rate of 7.5 per cent.

Under the low-growth (3.5 per cent) assumption, Saudi Arabia might be asked to produce 23 million barrels each day — almost triple the current rate of production, and probably not achievable.

With high growth (4.5 per cent), the daily demand by 1990 might be 35 million barrels a day. There is considerable doubt that the Saudi government will ever authorize production in excess of 16 million barrels per day.

If the world is to avoid a severe oil crunch, Canada and other nations must hold down the rate of growth of oil demand — by more aggressive conservation and development of alternatives to oil: coal, nuclear power, natural gas, and, to the degree possible, solar and other less conventional energy forms. President Carter's energy proposals constituted a major 1977 initiative covering these points, although some of the key elements had yet to be accepted by Congress at year end. Some of the same proposed actions have been taken in other nations.

For its part, Canada had already taken a major initial step in 1976, with the publication of the *Energy Strategy*, and in 1977 followed up with various policies and actions, some of which are highlighted in this report.

The *Energy Strategy* calls specifically for a reduction of growth in energy consumption to less than 3.5 per cent annually, and for steps to raise domestic oil prices toward international levels (though not necessarily all the way) and to assure that natural gas prices rise to an appropriate competitive relationship with oil.

One important method of restraining energy use is through better insulation. By the end of 1977, the federal and provincial governments were co-operating in the Canadian Home Insulation Program, involving \$1.4 billion worth of insulation grants over 7 years.

In 1977, federal-provincial agreement was reached under which crude oil prices will increase by \$4 per barrel between mid-1977 and January 1979. The aim of the price increases is twofold: to encourage energy thrift and to help assure a flow of investment into exploration and development of new sources of supply. Legislation has been introduced to provide the government with the information it needs to judge whether reinvestment is adequate.

Events of 1977 have confirmed that the prospects for making increased use of natural gas are relatively bright. The enlargement of known western Canadian reserves, which began in 1976, has continued, due largely to federal-provincial arrangements for higher prices. A continuing direct

federal investment is being made in far northern exploration, in an effort to extend earlier important discoveries. Legislation has been tabled which will establish new conditions for exploration and development in the Canadian north and in offshore areas.

After extensive consideration of alternate routes, Canada and the United States reached agreement on the construction of the Alaska Highway pipeline system through Alaska, the Yukon, British Columbia and Alberta. This line may eventually enable Canadian Arctic gas to reach Canadian consumers, through facilities shared with the United States.

The strengthening of delivery systems was recognized as an important policy goal by the *Energy Strategy*. These systems will make possible the use of natural gas (or other fuels) as an alternative to oil. Examples of developments now receiving study are the Polar Gas project, to connect Arctic Islands gas to Canadian markets; a system — backed by Petro-Canada, the national oil company — to ship liquefied natural gas by tanker to the Atlantic provinces; and a proposal by Petro-Canada and others to develop a new pipeline to provide eastern Quebec and the Atlantic provinces with western Canadian natural gas.

The Atlantic provinces and Quebec have been accustomed to rely on foreign oil to meet the majority of their transportation, heating and industrial needs. Quebec has, however, been able to cut its reliance on imports by about one half because of the extension of the Interprovincial Pipeline system from Sarnia to Montreal. The federal government promoted construction of that pipeline and has been meeting its operating costs.

The federal government is also assisting the Atlantic provinces to reduce their oil dependence with funding to improve building insulation, to develop replacement fuels, especially coal, and to support nuclear power generation. There have also been offers of assistance to the proposed Maritime Energy Corporation, and for various improvements in the generation and distribution of electrical power.

Nuclear power is an increasingly important source of electricity for Canada, which is blessed with a relative abundance of uranium fuel. Nuclear energy now provides about 20 per cent of Ontario's electrical requirements. New legislation has been introduced to define more clearly responsibility for health, safety, security and environmental regulation of nuclear power. The disposal of nuclear wastes was also the subject of a report to the federal government by an independent panel of experts. This panel concluded that there are good prospects for safe disposal of such wastes and urged that work on a national disposal plan commence immediately.

Through a balanced policy of demand restraint, supply expansion and accelerated research and development, Canada can achieve the goal established in *An Energy Strategy for Canada*. That goal is *Energy Self-Reliance*.

This booklet shows various aspects of the energy situation in graphic form, and summarizes some of the major events of 1977.

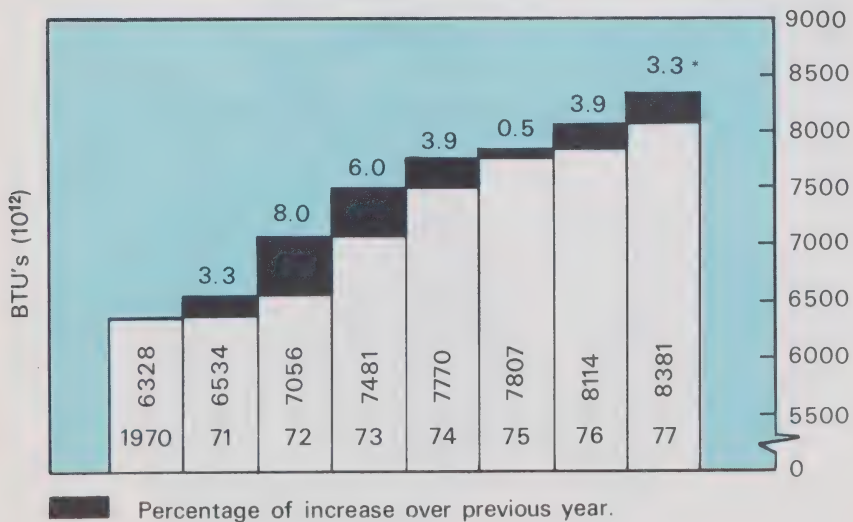
ENERGY USE AND CONSERVATION

Based on consumption in the first nine months of the year, a preliminary estimate is that in 1977 Canadians increased their energy consumption by approximately 3.3 per cent over 1976.

The industrial sector continued to be the major user of secondary energy, based on historic patterns. The latest accurate data, from 1975, show that industry consumed 33 per cent of secondary energy; transportation accounted for 26.2 per cent; the domestic and farm sector 19.8 per cent; commercial users 12.3 per cent; and the energy supply industries, including pipelines, 8.7 per cent.

Canadians remained heavily dependent on petroleum and natural gas, which supplies an estimated 64 per cent of primary energy supply. As can be seen from the energy commodity maps on pages 7 and 8, production and consumption of primary energy in Canada varied greatly from province to province but the overall national trend was to consume more of everything.

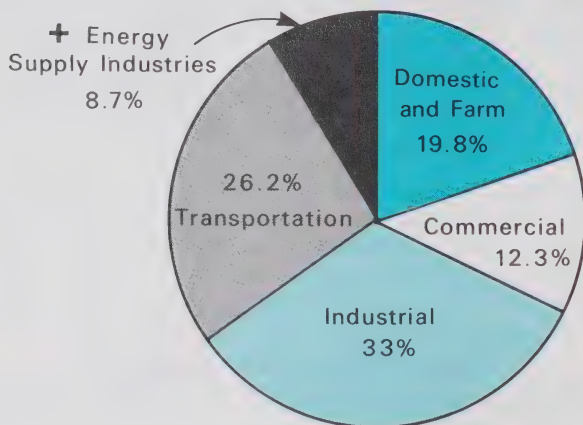
TOTAL PRIMARY ENERGY CONSUMPTION RATES FOR THE 1970s



* Preliminary values

Recent studies by Energy, Mines and Resources have indicated how the target of less than 3.5 per cent annual growth in primary energy consumption can be met. Assuming the right combination of circumstances, between now and 1990, the average annual growth in energy use could be in the range of 3.5 per cent to 2 per cent. Government can do its part by introducing pricing policies, regulations and incentives that encourage the more efficient use of energy, but Canadians, both individuals and businesses, must also respond voluntarily to attractive conservation opportunities. By using energy more efficiently, Canadians can slow down the rate of growth of energy demands, and, at the same time improve the performance of the Canadian economy.

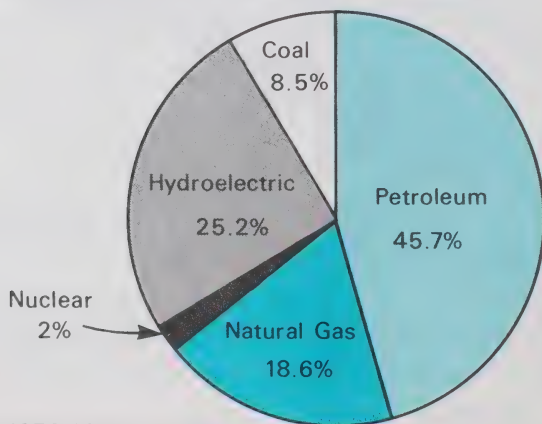
CONSUMPTION OF SECONDARY ENERGY*



* Statistics Canada, 1975

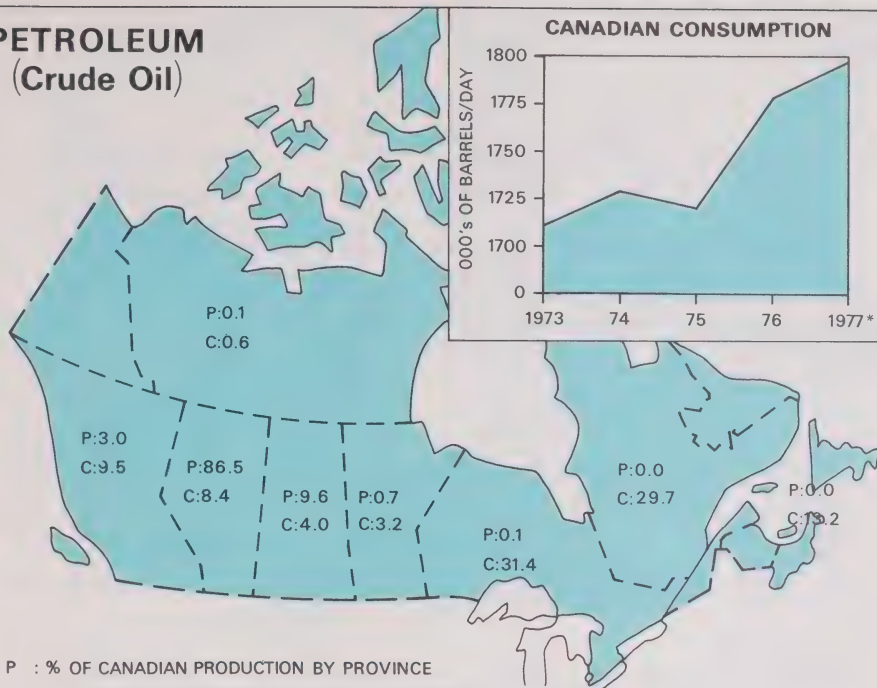
+ including pipelines

SOURCES OF PRIMARY ENERGY*



* 1976 EMR estimates

PETROLEUM (Crude Oil)



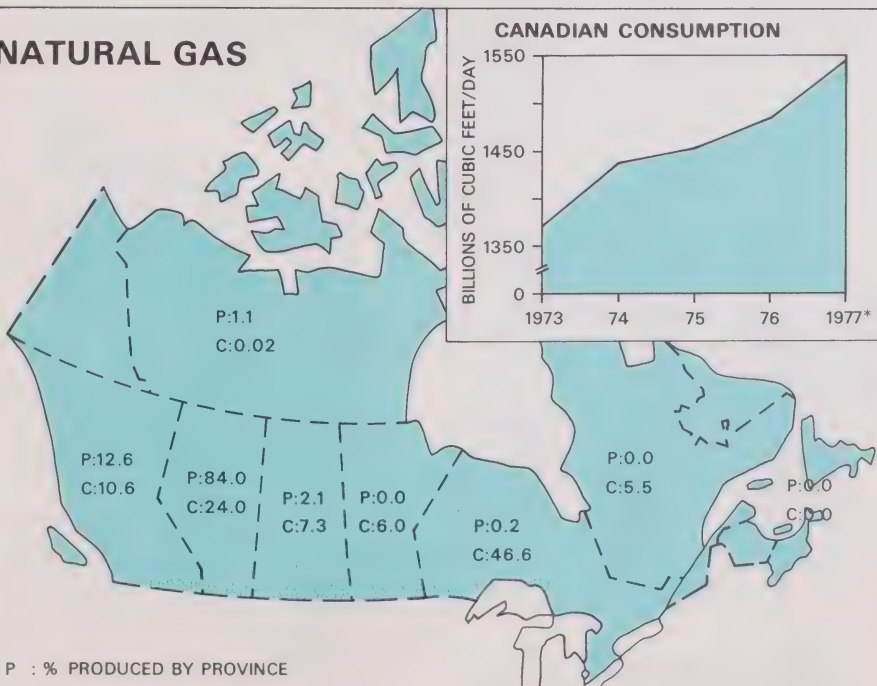
P : % OF CANADIAN PRODUCTION BY PROVINCE

C : % OF TOTAL CONSUMPTION, INCLUDING IMPORTS, BY PROVINCE

Note : Gross percentages are rounded to the nearest tenth of a percent.

* : Preliminary value.

NATURAL GAS



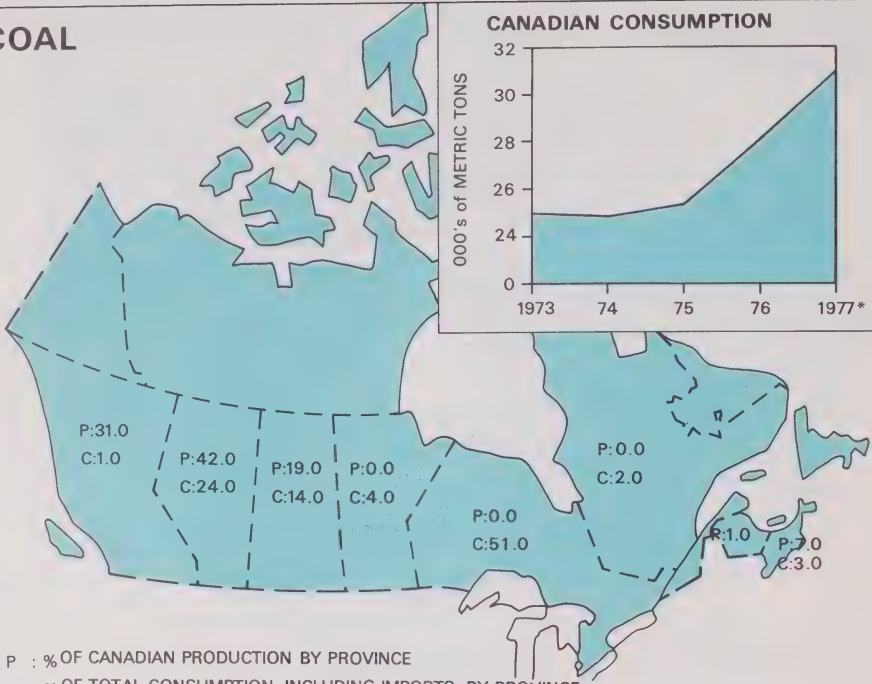
P : % PRODUCED BY PROVINCE

C : % CONSUMED BY PROVINCE

Note : Gross percentages are rounded to the nearest tenth of a percent.

* : Preliminary value

COAL



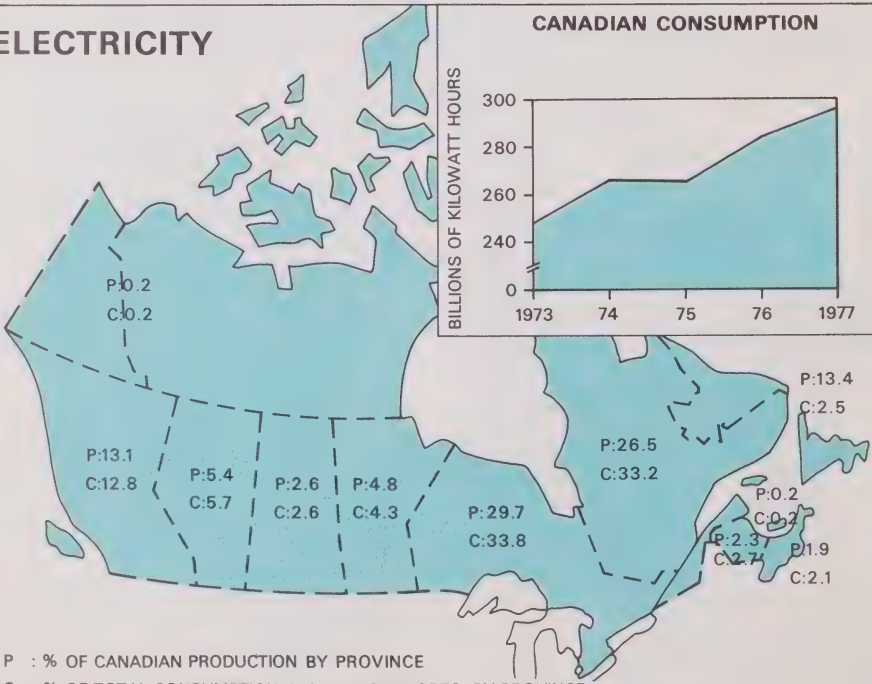
P : % OF CANADIAN PRODUCTION BY PROVINCE

C : % OF TOTAL CONSUMPTION, INCLUDING IMPORTS, BY PROVINCE

Note : Gross percentages are rounded to the nearest tenth of a percent.

* : Preliminary value

ELECTRICITY



P : % OF CANADIAN PRODUCTION BY PROVINCE

C : % OF TOTAL CONSUMPTION, INCLUDING IMPORTS, BY PROVINCE

Note : Gross percentages are rounded to the nearest tenth of a percent.

* : Preliminary value.

Some related events —

INSULATION PROGRAM

The federal government proposed a series of energy conservation initiatives on June 27, aimed at reducing the average annual rate of growth of energy use in Canada. The main item was a \$1.4 billion federally funded Canadian Home Insulation Program (CHIP), to run for seven years. By year end, an agreement had been worked out with the ten provinces under which they would voluntarily pursue such measures as tightening building codes, lowering speed limits, removing insulation sales taxes and revising electrical metering practices to save energy.

LABOUR INTENSIVE PROGRAM

More than \$19 million was allocated to EMR's Office of Energy Conservation in mid-December under the Federal Labour Intensive Program (FLIP) to provide employment for 2 100 persons to staff energy conservation projects in New Brunswick, Quebec, Ontario and British Columbia. The FLIP workers will be employed in three projects — community and regional conservation and resource centres; re-insulation assistance for disadvantaged persons; and efficiency tests of household heating units.

NOVA SCOTIA PROGRAM

The federal government announced an \$80 million program for Nova Scotia in February, designed to encourage conservation of energy and a reduction of the province's dependence on imported oil. A similar program in a \$12 million fund was announced two months earlier for Prince Edward Island. The plan, under agreement with the provincial governments, provides grants for home re-insulation and extensive auditing of home and industrial energy use.

ENERGY VANS

EMR dispatched a fleet of seven energy vans to eastern and central Canada early in 1977, equipped and staffed for educational energy conservation programs. Four vans were based in Nova Scotia, Prince Edward Island, and New Brunswick, and one each in southern Ontario, Quebec and Manitoba, visiting shopping centres, high schools, service

clubs, churches and citizen organizations in both remote and major centres, illustrating and explaining how less energy can be used more effectively. In addition, under the "Enersave" program, three energy audit buses operated in Nova Scotia and Prince Edward Island, monitoring energy use in industries and businesses.

STUDENT PROGRAM

More than 1 000 students were employed during the summer by EMR's Office of Energy Conservation, providing information on the economic use of energy by homeowners and small businesses. The conservation message was also taken to school children utilizing skits and film.

SAVE 10

"Save 10", the conservation program being followed in federal government use of energy, resulted in an 8.9 per cent cut in energy consumption, just short of the 10 per cent target. The reduction is equivalent to about 1.4 million barrels of oil, or enough energy to heat 5 000 private homes. As a result, an additional effort will be made during the 1977-78 period with \$5 million listed for improved insulation in government-owned buildings. Another area of improvement involves a new supplement to the National Building Code for newer buildings, which will make buildings more energy efficient. Five federal departments have already adopted the new code.

NEW TARGET

A federal policy paper explored the possibility of cutting the annual increase in energy use below the more general target of "less than 3.5 per cent." The paper says a 2 per cent aim is uncertain, but could be attained "given the right circumstances", taking into consideration future socio-economic and technological developments.

CONSERVATION HOUSE

A prototype of a fully energy-efficient house was constructed in Regina during 1977. Called the Saskatchewan Conservation House, the structure demonstrated the requirements for reducing

home energy consumption by 85 per cent. A number of provincial agencies and universities were involved in the project, and assistance was also provided by the National Research Council's Division of Building Research.

PROVINCIAL PROGRAMS

During 1977, Nova Scotia, British Columbia and Saskatchewan joined Prince Edward Island and Ontario in installing energy conservation programs covering a wide range of topics.

IERD PROGRAM

The federal government in 1977 launched the \$1.5 million Industry Energy Research and Development program (IERD). Several projects have been funded under this conservation plan, which aims to help industry develop new or modified energy-efficient industrial processes.

INDUSTRY TASK FORCES

Canada's chemical industries, in a drive to improve energy efficiency, resolved to reduce energy consumption by 17 per cent per unit of production by 1980 as compared to 1972. The energy economy program was revealed during a November energy conservation seminar sponsored by the Chemical Industry Task Force.

Three more industries — plastics, forest products and oil refineries — formed energy efficiency task forces during 1977, adding to the nation's industrial groups already pressing co-operatively for energy-efficient operations. The others include: electrical and electronic industries; ferrous and non-ferrous metals; the food and beverage industries; mechanical machinery; industrial minerals; pulp and paper; textiles; and the transportation equipment industries.

CONSUMER PRICES

The well-head or field price for domestic crude oil and natural gas increased in two stages during the year in accordance with a schedule set by federal-provincial agreements. But Canadian oil and natural gas prices remained lower than world prices and consumers continued to pay less for oil products than in many other nations. Federal subsidies, financed by export charge revenues and a 10¢ per gallon gasoline excise tax, protected consumers in Quebec and Atlantic Canada from world price levels.

Higher domestic prices have stimulated increased exploration for higher-cost Canadian resources, promoted more efficient use of energy, and are helping us gradually adjust to more costly energy resources on which we will soon depend.

PRICES IN CENTS PER CANADIAN GALLON
(October 1977)

	Heating Oil (Including all taxes)	Gasoline, Regular (Taxes in brackets)
France (Paris)	79.1	2.22 (1.35)
Sweden (Stockholm)	62.4	1.67 (.86)
U.K. (London)	71.3	1.44 (.73)
U.S.A. (New York)	61.8	.81 (.17)
Canada (Ottawa)	54.6	.88 (.34)*

*Includes federal and provincial taxes.

CHANGES IN PRICES

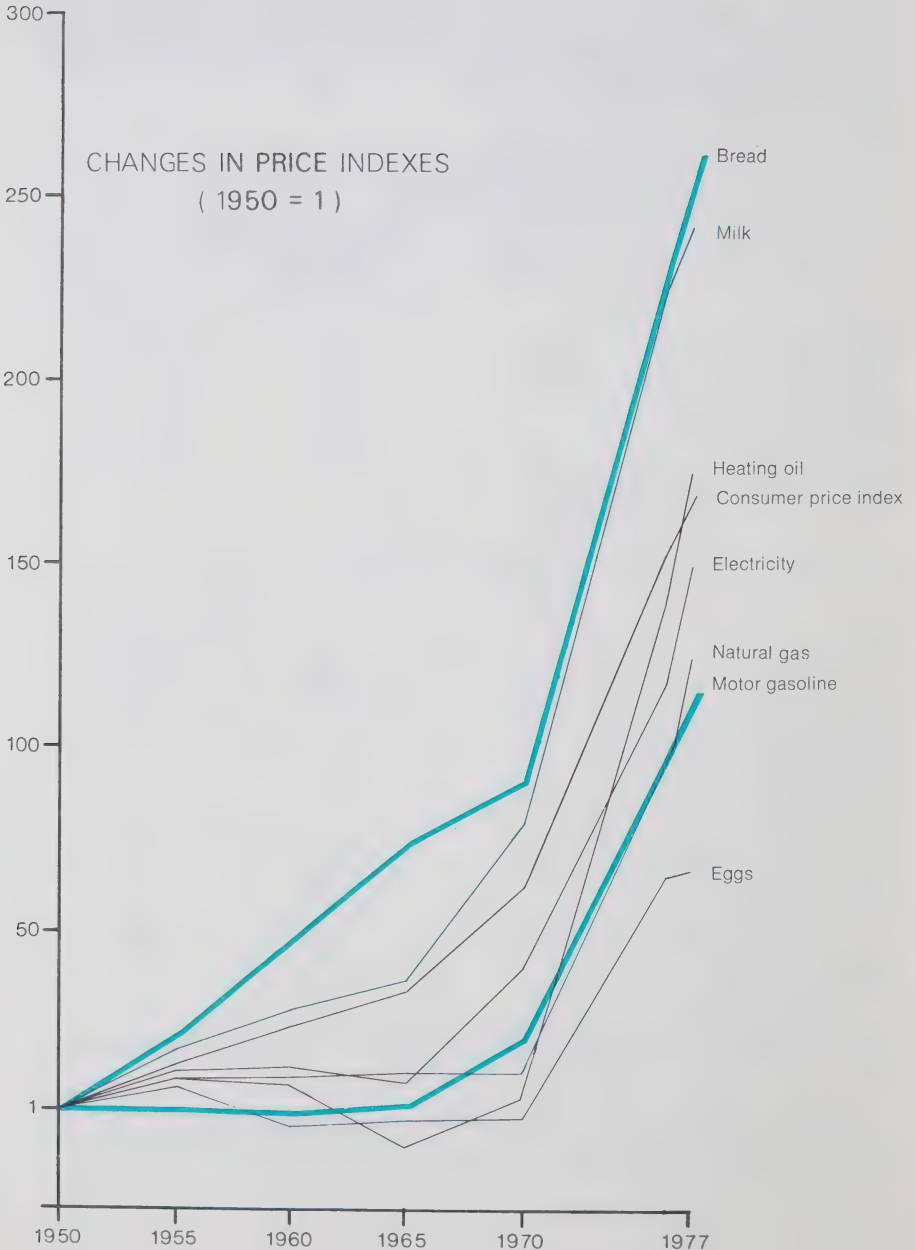
	1950	1977	Expressed in 1950 buying power
	(cents)	Actual (cents)	(cents)
Heating oil (per gallon)	18	50	18
Natural gas (per thousand cubic feet)	93	208	77
Electricity (per 100 kilowatt- hour)	114	286	106
Motor gasoline (per gallon) ..	41	88	33
Milk (per quart homogenized)	17	59	22
Bread (per loaf)	13	48	18
Eggs (per dozen, Grade A large)	56	93	35

Source: Prices based on Statistics Canada Calculated Prices (averaged) for September of each year and EMR Estimates.

As can be seen from the table above and graph on page 12, over the last 25 years energy prices for the consumer have been increasing at a

slower rate than the prices of two basic foodstuffs, bread and milk. Most energy prices have increased at a slower rate than the overall consumer price index. Since 1973, however, the prices of energy commodities such as heating oil, natural gas, gasoline and electricity have increased at about the same rate as the prices of bread and milk.

AVERAGE ANNUAL CONSUMER PRICES FOR FOOD AND ENERGY ITEMS



OIL AND NATURAL GAS

Exploration

Oil and natural gas exploration and development expenditures in Canada during 1977 are expected to surpass the 1976 record of \$1 176 million. The combination of higher well-head prices and provincial drilling incentives resulted in a dramatic increase in exploration spending in western Canada. This drilling activity paid off in a significant expansion of our gas reserves as 80 per cent of the record 6 300 wells drilled were for natural gas exploration and development.

Additions to our natural gas reserves from shallow producing horizons such as those found in the Suffield Block in southeastern Alberta have been well ahead of the annual consumption rate. These drilling successes have spurred additional programs across the Prairies.

Exploration continued in the Beaufort Sea although some major companies deferred or suspended on-shore activities when the National Energy Board recommended against the Canadian Arctic Gas Pipeline Limited application to build a gas pipeline up the Mackenzie Valley. Dome Petroleum made three significant gas discoveries offshore in the Beaufort Sea. Pan-arctic Oils Limited continued its drilling program on the Arctic Islands and offshore in an effort to add to known natural gas reserves.

A highlight of the exploration activity was the discovery of a potentially important oil field in the West Pembina area of Alberta. The last major oil discovery anywhere in Canada took place in 1965. Oil reserves have been steadily declining since 1969 as production has constantly outstripped additions to reserves.

Overall, approximately 85 per cent of the 1977 drilling activity took place in Alberta. Exploration activity also rose in Saskatchewan and in British Columbia, with successful drilling in the Sukunka-Grizzley area. Drilling activity declined in Manitoba and the frontier regions.

Costs of exploring for oil and natural gas and then developing any discoveries vary tremendously according to conditions, climate and location as can be seen in the table on page 14.

To spur exploration and development in Canada's Arctic and Eastern Offshore areas, federal income tax measures provide incentives for reinvestment, allow deferment of tax payments through fast write-offs of expenditures, and forego revenue through earned depletion. For example, in the Beaufort Sea area where offshore exploration wells cost \$25-30 million, a company in a taxable position need find no more than 7¢ of every dollar it spends on well costs of over \$5 million. The remainder comes from deferred income tax and a higher level of earned depletion. If commercial production eventually follows, the deferred income tax will be paid.

As an additional incentive to accelerate early frontier exploration, industry will be given a three-year exemption from payment of the new progressive incremental royalty on production resulting from any discoveries made in the frontier regions prior to October 31, 1982. This incentive was part of the fiscal regime proposed in the Canada Oil and Gas Act, which was introduced in Parliament in December.

AVERAGE DRILLING COSTS IN WESTERN CANADA AND OFFSHORE, 1976

	Alberta	Other Western Provinces	Northwest Territories, Yukon and Arctic	East Coast Offshore
Drilling costs				
\$ per development				
foot	29.82	69.65	135.30	—
\$ per exploratory				
foot	40.00	46.90	1 051.73	243.14
\$ per total foot	33.98	57.16	770.70	243.14
\$ per development				
well	81 808.	257 960.	1 267 556.	—
\$ per exploratory				
well	165 774.	317 521.	11 138 889.	4 818 200.
\$ per total				
well	108 129.	283 482.	7 848 444.	4 818 200.

Source: Statistics Canada and Canadian Petroleum Association.

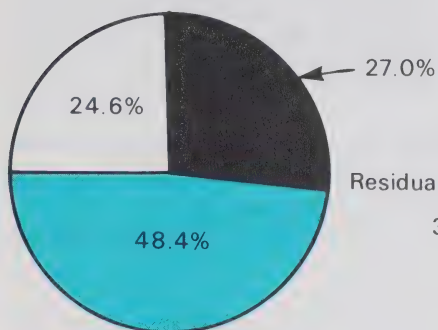
Reinvestment of Revenues

By federal-provincial agreement the price for Canadian crude oil at the well-head rose from \$9.75 to \$10.75 on July 1, 1977 and to \$11.75 on January 1, 1978. A barrel of imported oil landed in Montreal at year's end cost about \$15.50. Natural gas prices at the Toronto "city-gate" rose in two steps from \$1.505 per thousand cubic feet to reach \$1.85 per thousand cubic feet by February 1, 1978.

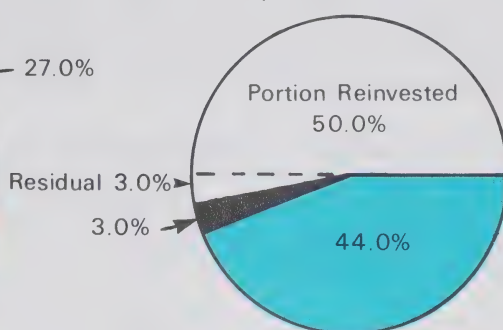
An increase of \$1.00 per barrel at the well-head for Canadian crude oil is shared by governments and private industry in the following manner. If there is no increase in exploration, the provincial government would gain 48.4¢; the federal share would be 27¢; and the oil and gas industry would get 24.6¢. If the industry increases exploration spending by 50¢ per barrel, its share of the price increases would rise to 53¢; the provincial government's share would fall to 44¢; and the federal government would be left with 3¢ of the dollar increase. If industry reinvests 57¢ per barrel in exploration the federal share of additional production revenues could fall to 0¢. This formula for sharing new revenues excludes the impact of provincial programs.

DISTRIBUTION OF INCREMENTAL NET REVENUES FROM AN INCREASE OF \$1.00/BBL IN CRUDE OIL

Assuming no increased
exploration



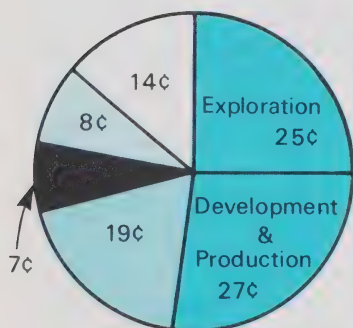
Assuming increased
exploration of 50¢



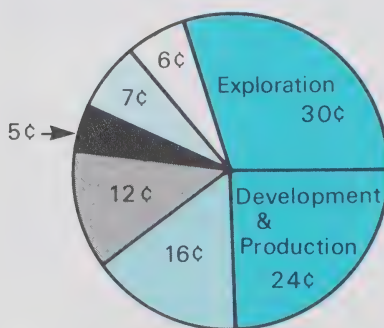
- Provincial Government share
- Federal Government share
- Industry share

INDUSTRY USE OF \$1.00 OF INTERNALLY GENERATED FUNDS

1976



1st Half 1977



- Others
- Dividends
- Other Working Capital

- Inventories & Accounts Receivable less Paid
- Refining, Marketing, Transportation & Chemicals

For the first time in six years the Canadian petroleum industry was spending a larger part of their cash-flow on exploration than for any other capital expenditure during 1977. From information provided by a representative sample of about 80 per cent of the industry, taken by EMR in the first half of 1977, pure exploration expenditures could increase about 43 per cent over the amount spent in 1976. Total exploration, development and production expenditures are expected to rise by nearly 20 per cent for the whole of 1977 and total capital expenditures in Canada by the industry is expected to increase by about 12 per cent.

Since 1973-74, the federal government's energy-related expenditures have roughly matched federal energy revenues. As can be seen from the table below, the federal government has not been reaping large net revenues from the higher domestic and export crude oil and natural gas prices and from the excise tax on gasoline.

For example, the federal share from July 1, 1977 and January 1, 1978 increases of \$1.00 each will depend on the level of reinvestment by the oil industry. Using industry's 1976 reinvestment pattern as a yardstick, the federal government's share of the increases — after increased equalization payments to the provinces — may be about \$50 million. In addition, the industry will have earned a \$35 million tax credit useable against future income. This potential federal income is insignificant when compared to federal energy exploration, research and conservation spending.

FEDERAL GOVERNMENT'S ENERGY-RELATED EXPENDITURES AND OIL- AND GAS-RELATED REVENUES, 1973-77, IN MILLIONS OF DOLLARS

	1973-74	1974-75	1975-76	1976-77
ENERGY EXPENDITURES				
Oil compensation payments	157.0	1 162.0	1 582.0	945.3
Additional equalization payments				
attributable to provincial oil				
and gas revenues	253.0	370.0	448.0	484.0
Energy research and development	106.0	105.0	114.0	120.0
Energy conservation				67.5
Other energy projects	55.0	105.0	330.0	475.6
Total expenditures	571.0	1 742.0	2 474.0	2 092.4
OIL- AND GAS-RELATED REVENUES				
Oil export charge	287.0	1 669.0	1 063.0	660.0
Gasoline tax			399.0	557.8
Corporate income tax	220.0	504.0	770.0	862.0
Total revenues	507.0	2 173.0	2 232.0	2 079.8
BALANCE OF OIL AND GAS				
RELATED REVENUES LESS				
ENERGY EXPENDITURES	(64.0)	431.0	(242.0)	(12.6)

Some related events —

EXPLORATION IN ALBERTA AND BRITISH COLUMBIA

During 1977, exploratory drilling reached record proportions and from all indications activity will remain high in 1978, particularly if oil and gas prices continue to rise towards world levels. Additions to gas reserves, which fell below annual production levels in 1972 and 1973, are currently well above annual consumption rates.

The foothills and deep basin areas of western Alberta were again prime targets in 1977 for industry exploration in the established producing regions of western Canada. At least 14 significant deeper zone gas discoveries were drilled in Alberta during the year.

In British Columbia, the upswing in 1976 exploration activity was maintained in 1977. The highlight of industry activity in British Columbia was the successful exploratory and development drilling in the foothills belt adjacent to the Alberta border.

PEMBINA DISCOVERY

The petroleum highlight of the year was the discovery of Devonian oil in the West Pembina area of central Alberta.

Alberta Energy Minister Don R. Getty in commenting on the Pembina-Brazeau area discoveries said, "I believe it is fair to say the discoveries reported to date are the most exciting developments on the Alberta oil and gas scene in more than a decade."

By the end of 1977, more than 30 deep exploratory wells were either being drilled or were in the evaluation stage. Preliminary estimates suggested it could be the first major oil-producing trend discovered since 1965.

SWEET GAS FIND

The discovery of ample quantities of sweet, dry natural gas southwest of Grande Prairie, Alberta, created a flurry of activity in the petroleum industry. The discoveries, located in the Wapiti Basin, are geologically related to a wave of natural gas interest across the provincial boundary in British Columbia.

RECORD LAND SALES

As a result of excitement from new oil and gas discoveries in Alberta, 1977 became a boom year for the province's petroleum and natural gas land sales. To the end of the year total revenues reached \$576.7 million, some \$416.6 million more than in 1976.

In one day, December 13, the Alberta Department of Energy and Resources recorded sales totalling \$49.5 million. The major sale was made to Chevron Standard Ltd., which paid a record-breaking \$20 565.93 per acre for a 640-acre lease for a total of more than \$13 million for lands in North Pembina. The Chevron bid topped the previous per acre record of \$19 437.50 paid by Texaco in May 1952.

Another parcel of 60 leases offered sold for a total of \$29.27 million in the very active West Pembina area of west-central Alberta. A number of other groups of leases were readily absorbed by representatives of the oil and natural gas industry in the province.

NORTHERN EXPLORATION

Three new discovery wells were drilled in the western Arctic by Dome Petroleum during 1977 — two natural gas wells, and one oil well. Further drilling must be carried out to determine the commercial significance of these discoveries.

SCOTIAN SHELF EXPLORATION

During 1977, Petro-Canada spent about \$12 million for drilling on acreage held by Shell and Mobil. At mid-year, Petro-Canada commenced a five-year exploratory and evaluation drilling program in the Sable Island area, to determine the feasibility of commercial production from the small discoveries that have been made in this region. The first well in this program was completed by the end of the year.

LABRADOR EXPLORATION

There was no drilling off Labrador during 1977.

CANADA OIL AND GAS ACT

In December, the federal government introduced a bill in Parliament to regulate the disposition and development of

oil and gas rights on Canada Lands. This bill will implement policy intentions first announced in May 1976, and will apply to about 1.3 billion acres of Crown reserve land in Canada's northern and offshore regions. It includes a minimum 25 per cent Canadian participation requirement for obtaining a production licence, provisions to give special rights to Petro-Canada, including a limited (up to 25 per cent) "back-in" privilege on leases up for renewal where no discovery has been made, and the establishment of an environmental studies fund. The new fiscal system outlined in the bill consists of a basic 10 per cent production royalty combined with a progressive incremental royalty; the latter will be based on the profitability of individual discoveries. The bill also allows Ministerial discretion in terms of ordering drilling or production, setting the fair market value and altering any fiscal burden.

OFFSHORE RESOURCES

Agreement was reached between the federal government and the three Maritime Provinces to a joint administration of offshore resources, with a 75/25 per cent sharing of revenues in favor of the provinces. The Newfoundland government is contesting federal ownership of offshore rights, and has agreed in principle that a joint reference should be made to the Supreme Court of Canada by the two governments. An interim agreement has been reached that will allow a joint approach to industry at the operational stage until the legal questions have been resolved.

SASKATCHEWAN EXPLORATION

Oil and gas exploration in Saskatchewan was very active in 1977, showing an increase of more than 100 per cent over 1976. A total of 529 wells were drilled — 167 more than the total for 1976. In the intensive search for heavy oil in the Lloydminster area, 244 new wells were drilled, nearly double the 126 wells drilled in 1976. Completed wells in the province showed a sharp increase, with 333 oil wells completed in 1977, compared to 146 in 1976, and 66 gas wells completed, compared to 25 completions in the previous year.

CIGOL/SASKATCHEWAN RULING

The Supreme Court of Canada late in November ruled invalid the mineral in-

come tax and the royalty surcharge on crude oil which the Saskatchewan government had been collecting. The court said the Saskatchewan government was in effect fixing the price of oil with taxes. The decision set the stage for possible demands by affected oil companies for tax and royalty surcharge refunds of as much as \$600 million, plus interest.

The Saskatchewan government a week later introduced new legislation, the *Oil Well Income Tax Act*, retroactive to 1974. The new legislation, still pending at year's end, would replace the unconstitutional taxes with an income tax, which provinces are permitted under the constitution. Norcen Energy Resources Ltd., the company that won the decision, took over Canadian Industrial Gas and Oil Ltd. (CIGOL) after its claim against the government was filed.

MONITORING BILL

The proposed Petroleum Corporations Monitoring Act was introduced for Parliamentary approval November 2. The bill is designed to provide assurance that revenue from increased oil and gas prices is being invested by industry in greater exploration and development in Canada. It would require companies to file semi-annual reports listing details of all sources and disposition of funds.

INTEGRATED POLICIES NEEDED

The financing to maintain future Canadian energy supplies is closely related to the health of the Canadian economy, according to a study entitled *The Availability of Capital to Fund the Development of Canadian Energy Supplies*, published in November by the newly established Canadian Energy Research Institute. The report says energy investment policies at the national and provincial levels have to be integrated with the country's overall economic policies, since the desired growth of energy supply will be more difficult to achieve and maintain in a poorly functioning Canadian economy.

The Canadian Energy Research Institute is sponsored by the federal Department of Energy, Mines and Resources, the Alberta Department of Energy and Natural Resources, the Private Energy Research Association, and the University of Calgary.

Production, Imports and Exports

Petroleum production increased from a daily average of 1 598 000 barrels of crude oil and equivalent (including gas plant liquefied natural gases) in 1976 to 1 606 000 barrels in 1977; the average daily exports to the United States dropped from 641 000 barrels to 533 000 barrels in 1977; the estimated daily average consumption reached 1 797 000 barrels, up from 1 777 000 in 1976; and imports dropped from 755 000 barrels per day to an estimated average of 725 000 barrels.*

In the past year, the average daily exports of petroleum were made up of 272 000 barrels of crude oil and equivalent (down from 465 000 barrels in 1976); 126 000 barrels of gas plant liquefied petroleum gases (including propane and butane); 80 000 barrels of refined petroleum products, such as motor gasoline, heavy fuel oil and diesel fuel; and 55 000 barrels of "swap oil". Imports in 1977 consisted of 617 000 barrels of crude oil and equivalent (down from 755 000 in the previous year); the 55 000 barrels of "swap oil"; and 53 000 barrels of refined petroleum products.

The National Energy Board has been regulating both the price and the amount of petroleum and natural gas liquids exports to the United States since 1973. Allowable exports are reviewed monthly in keeping with the federal government's objective of phasing out all crude oil exports, except for heavy crude oils, by 1981. The 1977 increase in domestic demand was largely off-set by the 36 per cent reduction in exports to the United States. Export volumes will be reduced again in 1978.

Export charges for crude oil and equivalent hydrocarbons after February 1, 1978, were \$4.85 per barrel for light crude oils and condensate, \$2.80 per barrel for Lloydminster, Viking-Kinsella and Wainwright type crude oil blends, and \$3.25 per barrel for other designated heavy oils. Charges on licensed exports of petroleum products as of February 1, 1978 were \$3.60 per barrel for motor gasoline and gasoline components and middle distillates, \$2.45 for heavy fuel oil, and \$4.85 per barrel for partially processed oil.

Total Canadian natural gas production increased by an estimated 100 million cubic feet per day to 6.8 billion cubic feet per day, matching a corresponding increase in the domestic use of gas from 4.1 to 4.2 billion cubic feet per day. The increase in demand came from industrial users of natural gas. Exports of natural gas to the United States increased marginally over the long-term-contract amounts of 2.6 billion cubic feet per day. This marginal increase was due to the emergency provision of natural gas to meet severe local shortages in the United States during a long, very cold spell.

The border price of Canadian natural gas rose in two stages from \$1.80 (Can.) per thousand cubic feet in January 1977 to \$2.16 (U.S.) per thousand cubic feet in September. Export prices will be reviewed again early in 1978.

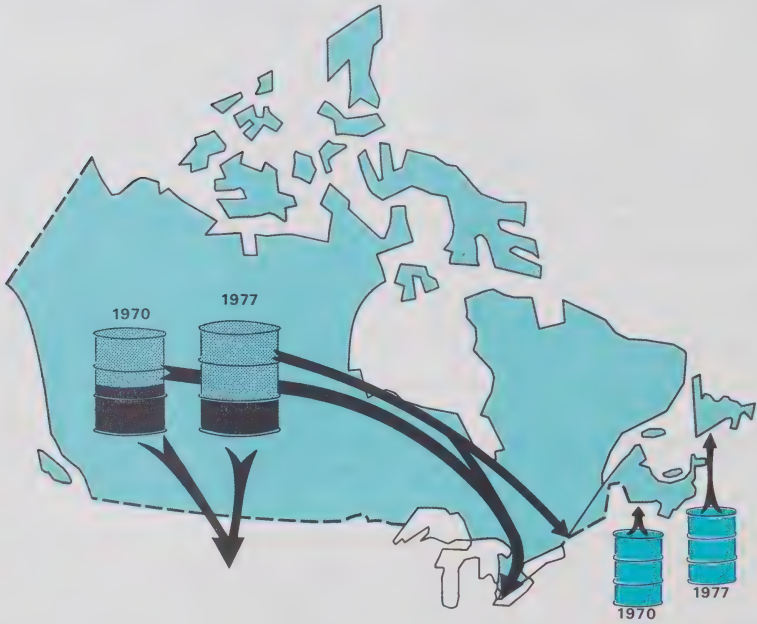
Preliminary estimates indicated that Canada's balance of total energy trade for 1977 stood at approximately \$1 322 million, due primarily to higher

*The small difference between availability (production plus net imports) and consumption results primarily from stock changes.

export prices. Energy exports, which included radioactive ores, electricity, coal and coke, natural gas, and crude oil and products brought in \$5 484 million; our overall energy imports cost \$4 162 million. However, Canada had a deficit of approximately \$1 100 million in crude oil and products trade. Natural gas accounted for the overall energy trade surplus as exports outstripped imports by a margin of \$1 822 million to \$35 000.

Under a program of federal assistance to areas of Canada dependent on higher-cost, foreign crude, oil importers receive compensation to enable them to buy at world prices and sell at the lower domestic price. Total payments made under the Oil Import Compensation program from 1974 to the end of 1977 were approximately \$4.6 billion.

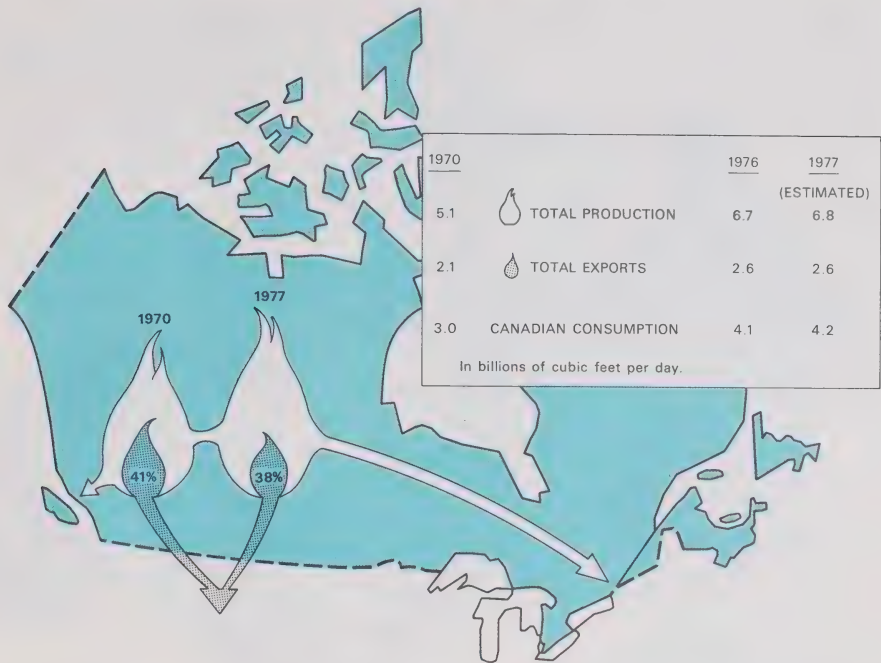
PETROLEUM IMPORTS AND EXPORTS



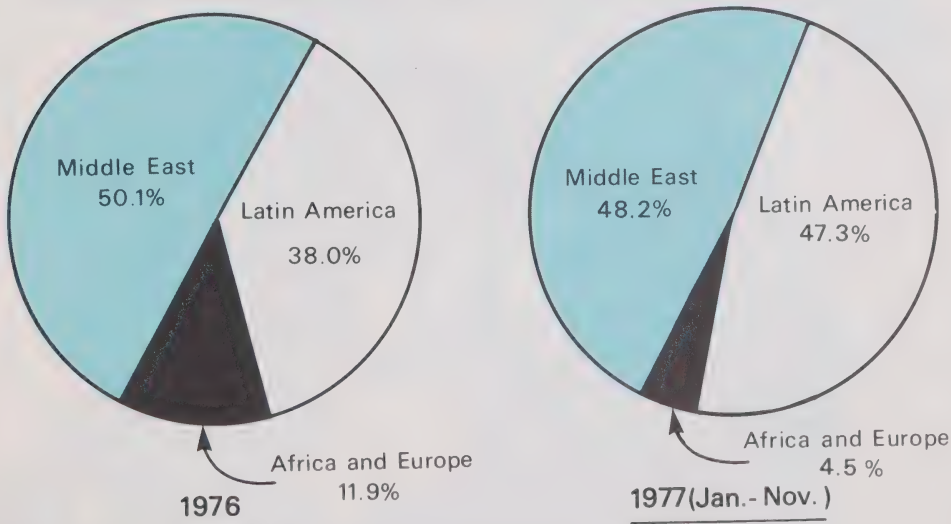
1970		1976	1977* (ESTIMATED AVERAGE)
1476 MB/D	TOTAL CANADIAN PRODUCTION	1598 MB/D	1606 MB/D
762 MB/D	IMPORTS	755 MB/D	725 MB/D
763 MB/D	EXPORTS	641 MB/D	533 MB/D
1475 MB/D	CONSUMPTION	1777 MB/D	1797 MB/D

MB/D : Thousands of barrels per day.
Includes refined products and liquefied petroleum gases.
* Both imports and exports include about 55 mb/d of exchange oil with the U.S.A.

NATURAL GAS EXPORTS



SOURCES OF CANADIAN CRUDE OIL IMPORTS*



* Excluding oil exchanged with the United States

Source: Statistics Canada

CANADA'S MAJOR OIL RESOURCE AREAS



CANADA'S MAJOR NATURAL GAS RESOURCE AREAS

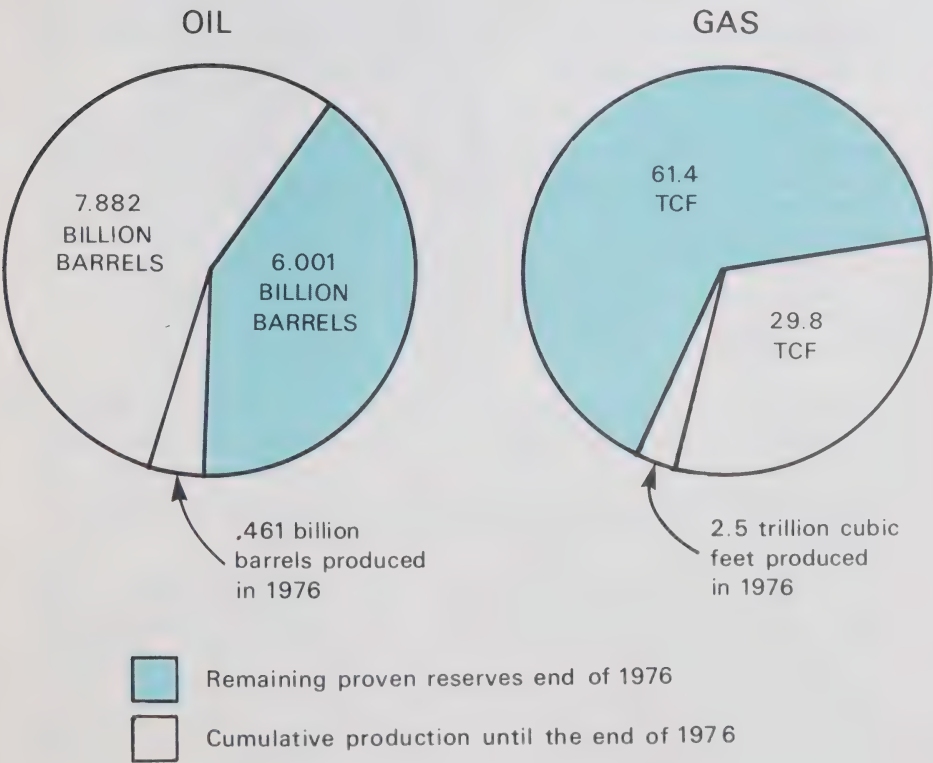


Reserves

The charts below, based on estimates prepared by the National Energy Board, give the amounts of oil and gas recoverable from Canada's proven conventional reserves at the end of 1976. That is to say, the amount we know to be available from Canada's oil and gas fields in marketable form. The oil figures include both light and heavy (28° API and below) conventional crudes. They do not include natural gas liquids.

The amount of heavy oil included is only a few hundred million barrels — the amount recoverable from the Lloydminster area of Saskatchewan and Alberta based upon historic recovery factors and depressed market conditions. The figures do not reflect the potential for increased recovery from such heavy oil deposits through improved technology. In the case of Lloydminster oil alone, advances in technology and improved economic conditions could result in from 1.5 to 4.5 billion barrels recoverable of crude oil.

RESERVES



Oil Sands and Heavy Oils

Nearly a hundred years ago, geologists from the federal Geological Survey of Canada described the oil sands of northeastern Alberta as "unequalled in the world" and proposed a process for extracting synthetic crude oil from the heavy, gritty, bitumen-soaked sand. But it wasn't until 1967 that this resource, equal to "almost half of the world's conventional oil supplies, a vital back-up supply" was tapped by a commercial synthetic crude oil operation, Great Canadian Oil Sands Limited (GCOS).

The oil sands consist of a varying mixture of sand, clay, minerals, water and crude bitumen, a substance something like asphalt. Bitumen is gathered around the grains of sand, separated by a thin film of water. In some areas, the oil sands can be found exposed or lying close to the surface. However, most of these oil sands lie buried beneath muskeg, soils and clays as much as 2 000 feet deep.

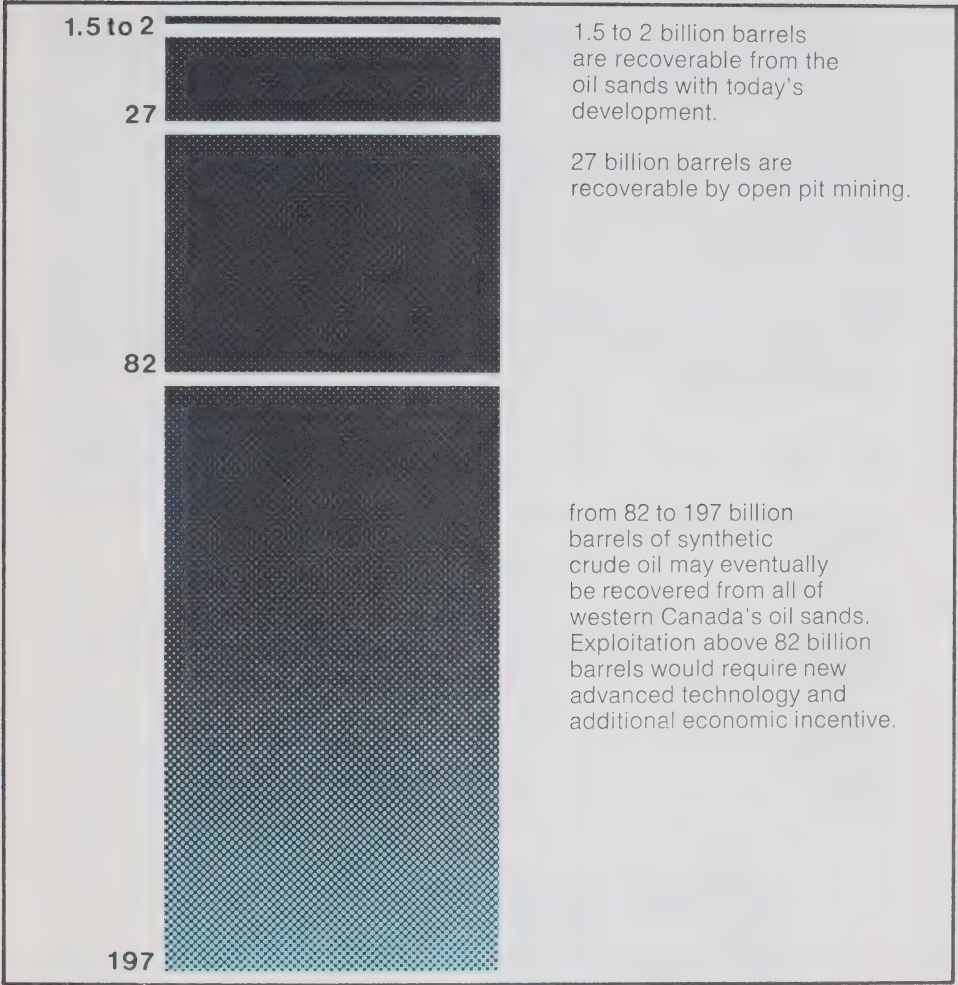
To obtain synthetic oil from the oil sands by today's techniques, the sand first must be mined, literally dug out of the ground. Then the bitumen must be separated from the sand and, finally, the raw bitumen must undergo a series of processes to upgrade it and convert it to a synthetic crude oil product for use in existing petroleum refineries. The oil sands will be high-cost but a secure energy source for Canada if suitable extraction techniques can be developed.

The maximum amount of synthetic oil that can be mined by open-pit operations is estimated to be 27 billion barrels. As yet there are no methods proven on a commercial scale to tap the great mass of oil sands in deep underground deposits. Depending on the development of new or more efficient technologies and on the cost, it has been estimated that up to 200 billion barrels of synthetic crude oil may eventually be recovered from western Canada's oil sands. Total bitumen reserves estimated to be "in place" — those in the ground prior to extraction and processing — are close to one trillion barrels.

In 1977, the one operational oil sands plant at Fort McMurray, (GCOS), produced an average of 43 715 barrels of synthetic crude oil per day, a drop of 4 655 barrels a day from 1976. A second open-pit mining operation, Syncrude, is scheduled to start up operations in 1978 but is not expected to reach its target of 129 000 barrels a day until after 1980.

A huge reserve of heavy oils is also found in the Cold Lake area of Alberta, but here the resource is something like molasses, held in porous rock and cannot be recovered with conventional techniques. In situ recovery, involving heating the oil to a point where it will begin to flow, is necessary. But the long lead times for providing suitable technologies and constructing commercial-scale projects will probably delay the production of significant amounts of synthetic crude oil until the mid- to late-1980's. These oils will also require pre-refining and upgrading. However, some heavy oil resources will become economic at world prices.

THE OIL SANDS



Heavy oils have been produced from conventional oil wells in the Lloydminster area for decades despite high costs, difficulties in transportation, and very limited markets. However improved methods of recovering the heavy oils from this field and current upgrading techniques may be employed to convert this resource to an important source of supply by the early 1980's.

It is estimated that Canada will need as much as 1 million barrels of synthetic crude oil a day by 1990 to meet increased domestic needs with steadily declining production from conventional crude oil reserves. That would mean at least another six plants the size of Syncrude, which has cost over \$2 billion.

The Refining of Petroleum

Crude oil can be put through a variety of refining processes and be made to yield several thousand products. These products can be divided into five major groups. They are light gases, light, middle and heavy distillates and the residues.

Products from the light gases at the "top of the barrel" include gas used for heat, light and power in refineries and industry; propane, butane and other liquefied petroleum products; and about 300 chemicals such as alcohols used in antifreeze.

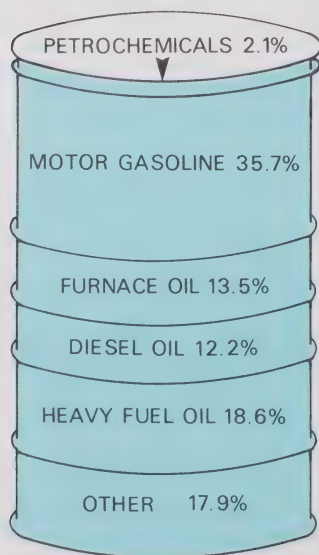
The best-known products of the light distillates are gasoline and aviation fuel. Specialty naphthas, used in explosives, solvents and dyes are also produced. Kerosenes, light heating oils and diesel fuel are refined from the middle distillates.

Heavy distillate products include lubricating oils along with paraffin waxes, white oils and petrolatums, which are used in salves and creams.

Asphalts, coke and residual fuel oils are the chief products of the heaviest group, the residuals.

Intermediate chemicals derived from petroleum, commonly called petrochemicals, form the base for major industries making plastics, synthetic textiles, paints, insecticides, photographic film and many other everyday items. Petroleum has been the centre of a chemical revolution.

The main products produced by Canadian refineries are shown below.



**AVERAGE CANADIAN
YIELD FROM A BARREL
OF PETROLEUM**

DATA IS FOR 1976

Some related events —

OIL PRODUCTION

SYNCRUDE

Construction of the Syncrude Canada Ltd., oil sands project near Fort McMurray was 95 per cent complete by the end of 1977. When it is in full operation between 1979 and 1982 it will be producing about 129 000 barrels a day. It will go into operation in two phases — the first in April 1978, producing more than 50 000 barrels a day, and the second about six months later, increasing the yield to about 108 000 barrels a day by 1980. Revised cost estimates at the end of the year indicated a final cost of \$2 191 million, marginally over the 1974 estimate of \$2 048 million. There is a possibility that the production capacity could be increased later to 200 000 barrels a day.

ALBERTA HEAVY OIL

Imperial Oil Limited in November applied to the Alberta Energy Resources Conservation Board (AERCB) to build and operate a major heavy-oil recovery and upgrading project near Cold Lake. The heavy oil, too thick to flow in its natural state, would be recovered using a thermal method, and upgraded to yield up to 120-140 thousand barrels of synthetic crude oil per day. Cost of the project over its entire life could be as high as \$4 billion; if it is approved, construction could start by 1981 and be completed by 1985.

UPGRADING PLANT

There are several plans under active consideration aimed at building a heavy oil upgrading facility which could produce up to 100 000 barrels a day. Exact costs of such a plant are not yet available and the final decision will depend on the economics, which in turn depend heavily on the capital investment needed.

FEDERAL/ALBERTA TASK FORCE ON OIL SANDS

Early in 1977 a task force was established by the federal and Alberta energy ministers to investigate possible commercial terms for new oil sands projects. Royalty levels, income taxes, pricing and financing were the items examined, and discussions were held with industry representatives. Reports from the task force members to their respective cabinet ministers are forming the basis for the formulation of a co-ordinated federal/provincial policy on the further development of this important resource.

FEDERAL/SASKATCHEWAN TASK FORCE

During the year a federal/provincial task force studied the problems of heavy-oil development in Saskatchewan, with the purpose of defining the tax and royalty arrangements that would be best suited to more rapid development of this underutilized resource. As a result of the study, new initiatives by both levels of government are expected to be taken in 1978.

IN SITU TEST PROGRAM

In July, the Alberta Energy Resources Conservation Board approved a joint proposal of the Shell Canada Resources Ltd., and the Alberta Oil Sands Technology and Research Authority (AOSTRA) for a \$60 million experimental in situ oil-sands program in the Peace River area. The test program, to get under way in the summer of 1978, will incorporate a new Shell recovery technique designed to produce 3 500 barrels of bitumen a day.

Numac Oil and Gas Ltd., in agreement with AOSTRA, began a \$1.6 million program to develop technology for recovering petroleum from Alberta's deeply buried oil sands, currently considered to be not recoverable.

COLD LAKE PROJECT

A three-company consortium made up of B.P. Canada Limited, Hudson's Bay Oil and Gas Company Limited, and Pan-Canadian Petroleum Limited entered an agreement in February with AOSTRA for a jointly funded in situ pilot plant to produce bitumen from Cold Lake heavy oil sands. The project will recover bitumen using combustion and steam. It is hoped the plant will be in commercial development by the mid-1980s.

AMOCO PILOT PLANT

The Alberta Oil Sands Technology and Research Authority (AOSTRA) and Amoco Canada Petroleum Company Ltd. signed a \$46 million agreement for development of an oil-sands extraction pilot plant to be located 30 miles south of Ft. McMurray. Using Amoco's patented 'Cofcaw' underground combustion technique, the company plans to reach a production level of 1 000 barrels a day by 1980.

JAPEX R & D PROGRAM

The Japan Petroleum Development Corporation (Japex) has accelerated its development plans for the extraction of oil from the Athabasca oil sands. Late in 1977 Japex said it proposes to expend some \$75 million in a research and development program for oil extraction from the oil sands.

Earlier, Japanese funding was announced for heavy oil extraction at Cold Lake.

WORLD PRICES FOR SYNTHETIC CRUDE OIL

The federal government introduced legislation in December to enable non-conventional oil from the oil sands and elsewhere to be marketed at the prevailing international price. For the next several years, the difference between that price and the lower domestic price would be covered by a levy on all oil processed and petroleum products imported into Canada.

NORTHERN PIPELINES

BERGER REPORT

Mr. Justice T. R. Berger's report on the social, economic and environmental impacts that an energy corridor and natural gas pipeline would have on the western Arctic and the Mackenzie Valley, was tabled in the House of Commons in May. The major recommendations were that no pipeline and no energy corridor be established across the northern Yukon, and that a pipeline along the Mackenzie Valley, proposed by Canadian Arctic Gas Pipeline Ltd., be postponed for ten years.

NEB RECOMMENDATION

In June the National Energy Board recommended to Cabinet approval of the proposal by Foothills Pipe Line (Yukon) Ltd. to construct a pipeline approximating the Alaska Highway to transmit Alaskan natural gas to the United States. The proposal included a proviso that, at a later date, a connecting line might be built to bring Mackenzie Delta and Beaufort Basin gas to Canadian markets.

ENVIRONMENTAL ASSESSMENT

The federal department of Fisheries and Environment announced in July that a natural gas pipeline through the southern Yukon, proposed by Foothills Pipe Line (Yukon) Ltd., would not seriously endanger wildlife and environment. The department suggested that before final approval is given, more studies to provide routing around wildlife and parks areas with proper environmental planning should be carried out. It added that the Yukon route is environmentally preferable to an earlier proposal to use the Mackenzie Valley.

LYSYK REPORT

The Alaska Highway Pipeline Inquiry (Lysyk Inquiry) reported in July to the Minister of Indian and Northern Affairs that, in its assessment, the social and economic impacts of a natural gas pipeline through the southern Yukon could be kept within acceptable limits, provided certain conditions were met. These involve: (1) certain financial and other

arrangements; (2) appropriate preventive and mitigative measures; and (3) sufficient time before construction of the pipeline begins to complete planning and to mobilize resources.

FOOTHILLS APPROVAL

The federal government in August gave Foothills Pipe Line (Yukon) Ltd., tentative approval for a natural gas pipeline for transmission of Alaskan gas crossing the Yukon, Alberta and British Columbia, with provision for a future interconnection with Mackenzie Valley gas.

AGREEMENT SIGNED

In late September, Canada and the United States signed an agreement for construction of a transmission line

through Canada to pipe Alaskan natural gas to United States markets. The agreement provides for Canada to add a spur line, if it is needed in the 1980's, to transport Canadian northern gas to domestic markets.

ARCTIC ISLANDS GAS

Polar Gas Ltd., a consortium including TransCanada PipeLines, Panarctic Oils Ltd., Tenneco Oil Canada Ltd., and the Ontario Energy Corporation, sought National Energy Board permission on December 21 to construct a 2 338-mile natural gas pipeline from the Arctic Islands to join the TransCanada Pipeline system at Longlac, 150 miles north of Thunder Bay. The application was also submitted to the Indian and Northern Affairs Department.

NATURAL GAS PROJECTS

LNG TANKER-ICEBREAKERS

With some 13 trillion cubic feet of natural gas discovered in the High Arctic to the end of 1977, consideration is being given to moving some of it by sea to a port on Canada's Atlantic coast. Such a plan could be in place by 1982 with a full investment of \$1.2 billion, according to a study by Melville Shipping Limited of Montreal. Reporting to its consortium partners — Petro-Canada Ltd. and Alberta Gas Trunk Line Ltd. — Melville Shipping stated that of two plans considered in the study, that of employing two specially designed LNG tanker-icebreakers was favored over the second scheme to use special barges towed by an icebreaking tug.

PANARCTIC

In addition to its ongoing exploration program in the eastern Arctic Islands, Panarctic Oils Ltd. is now taking preliminary steps towards production and transportation. At Drake Point on Melville Island, a special pipeline system is being prepared to carry natural gas to the island from an experimental offshore well that is expected to be completed early in 1978. At year's end, Panarctic also was planning to file an application for construction of a 112-mile pipeline from Drake Point to Dealy Harbour, site of a proposed gas liquefaction plant.

LNG PROJECT APPROVED

In December, Cabinet approval was given for NEB licences and certificates to three companies — Tenneco LNG Inc. of Houston, Texas, Lorneterm LNG Limited, and TransCanada PipeLines (New Brunswick) Limited — permitting the importation of Algerian liquefied natural gas by tanker at Lorneville, New Brunswick, for vaporization and export to the United States via pipeline.

The licences allow Tenneco to import/export up to 376 billion cubic feet of natural gas a year over a 20-year period, with deliveries expected to commence in 1983. The terminal facilities and vaporization plant will be completed in 1981, at a projected cost of \$636 million; the 66-mile pipeline from the plant to the Canada/United States border at St. Stephen, also to be completed in 1981, will cost \$68 million. At year's end, approval had yet to be obtained for construction and operation of the U.S. portion of the pipeline.

One condition of the Tenneco licence is that some gas, not exceeding 5 per cent of the volume imported from Algeria, be available for sale in Canada if terms and conditions are economically viable.

INTERNATIONAL PETROLEUM

CRUDE-OIL PRICING

Following a December 1976 meeting in Qatar a majority (11 of 13) of members of the organization of Petroleum Exporting Countries (OPEC) raised their prices for crude oil by 10 per cent on January 1, 1977, while Saudi Arabia and the United Arab Emirates (UAE) raised their prices by only 5 per cent. When the next OPEC meeting was convened in June, Saudi Arabia and the UAE raised their prices by 5 per cent to join the other members at a price of \$12.70 (U.S.) a barrel. At the same time, the group of 11 decided to forego a further July 1 increase of 5 per cent that had been agreed upon at the Qatar meeting. At the December meeting in Venezuela, OPEC members were unable to agree on an increase, so the price stood at \$12.70 (U.S.) at the beginning of 1978.

IAE ENERGY MINISTERS MEET

In early October, the energy ministers of the 19 member countries of the International Energy Agency met in Paris under the chairmanship of the Canadian minister, A. W. Gillespie. The IEA ministers adopted a 12-point energy pro-

gram aimed at holding oil imports in 1985 to no more than 26 million barrels per day (compared to 22 million barrels per day in 1976).

The target accepted by Mr. Gillespie on behalf of Canada was to limit oil imports in 1985 to one third of requirements, or 800 000 barrels, whichever is less.

INCREASED PRODUCTION

In 1977, increasing quantities of oil from sources other than the Organization of Petroleum Exporting Countries became available to world consumers. Oil production on the Alaskan North Slope began in June, and by the end of the year was averaging about 800 000 barrels per day. Daily production from the North Sea increased by 29.5 per cent from January to October — from 880 000 barrels to 1 140 000 barrels. In Mexico, production grew from 900 000 barrels per day in January to 1 030 000 barrels by October — a 14.4 per cent increase.

Overall, the supply of crude oil increased by 1 190 000 barrels daily due to increases in production from these three non-OPEC regions.

PETROCHEMICALS

GROWTH AT SARNIA

Petrosar Ltd.'s huge, \$650-million refinery/petrochemical complex at Sarnia started up during 1977, stimulating a number of secondary derivative industries in the area. Other Sarnia completions included Union Carbide Canada Ltd.'s high- and low-density polyethylene plant, with a capacity of 350 million pounds a year, and a 600-million-pounds-a-year styrene monomer plant by Polysar Ltd. Also, with Petrosar coming on stream, DuPont of Canada Ltd. increased the capacity of its polyethylene plant to 450 million pounds a year.

Shell Canada Ltd. is building a 150-million-pounds-a-year polypropylene plant at Sarnia which, when completed in 1978, will use feedstock from Petrosar. Shell also expects to complete its 200-million-pounds-a-year isopropyl alcohol plant in 1978.

ALBERTA PLANT NEARS COMPLETION

The emergence of a petrochemical industry in Alberta became more apparent in 1977, with further development of the

Alberta Gas Ethylene plant at Joffre, near Red Deer. Expected to come on stream late in 1978 or early in 1979, this facility will have the capacity to produce 1.2 billion pounds of ethylene per year.

The ethylene will be pipelined to Fort Saskatchewan, where Dow Chemical of Canada Ltd. will use it to produce vinyl chloride monomer and ethylene dichloride and glycols. The three Dow plants at Fort Saskatchewan, representing a total expenditure of more than \$250 million, are all expected to come on stream between mid-1979 and mid-1980.

The nearby \$50 million Diamond Shamrock Alberta Gas Plant which will be able to produce 220 million pounds of polyvinyl chloride per year, is also scheduled for completion in 1979.

HERCULES PLANT

In June, Hercules Canada Ltd. brought Canada's first polypropylene plant on stream at Montreal. With a capacity of 150 million pounds per year, this plant can supply all current domestic demand for polypropylene, with a surplus available for export.

ELECTRICITY

Preliminary estimates show that Canada's installed capacity to generate electricity increased by 3 825 megawatts in 1977 with the major expansion of facilities at Coleson Cove, New Brunswick; Nanticoke and Bruce, Ontario; Jenpeg and Long Spruce, Manitoba; Boundary Dam, Saskatchewan; Sundance, Alberta; and Mica Dam in British Columbia. This represented a 5.7 per cent increase to capacity and service at the end of 1976. About 5.4 per cent of total Canadian generation represented net exports of electricity.

The mid-1977 estimate for the year's electric utility capital expenditure was \$5 500 million — 26 per cent higher than 1976. This represented 18.9 per cent of total business expenditure for Canada.

Electricity prices continued to increase across the country to reflect rising costs of supply, especially for fuel and system expansion. Increases varied from about 10 per cent to nearly 50 per cent, depending on regional cost factors and on the date and adequacy of previous rate changes. Price increases are expected in every province during 1978, varying between about 5 per cent and 25 per cent.

The cost pressures were especially acute in the two provinces that depend most heavily on imported oil to generate electricity — Nova Scotia, where oil-fueled thermal plants provide over 60 per cent of the electrical supply, and Prince Edward Island, where they provide close to 100 per cent. In Quebec, Ontario and Nova Scotia, rate structures came under scrutiny with interest shown in peak period and marginal pricing. A hearing into the appropriateness of marginal costing and pricing of electricity for Ontario was initiated during 1977. It is expected that this hearing will be completed during 1978. Pricing of electricity in several other parts of the country may be guided by the outcome of the Ontario hearings.

SAMPLE MONTHLY ELECTRICITY BILLS

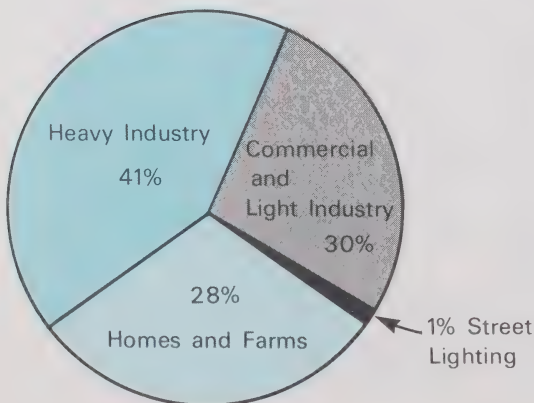
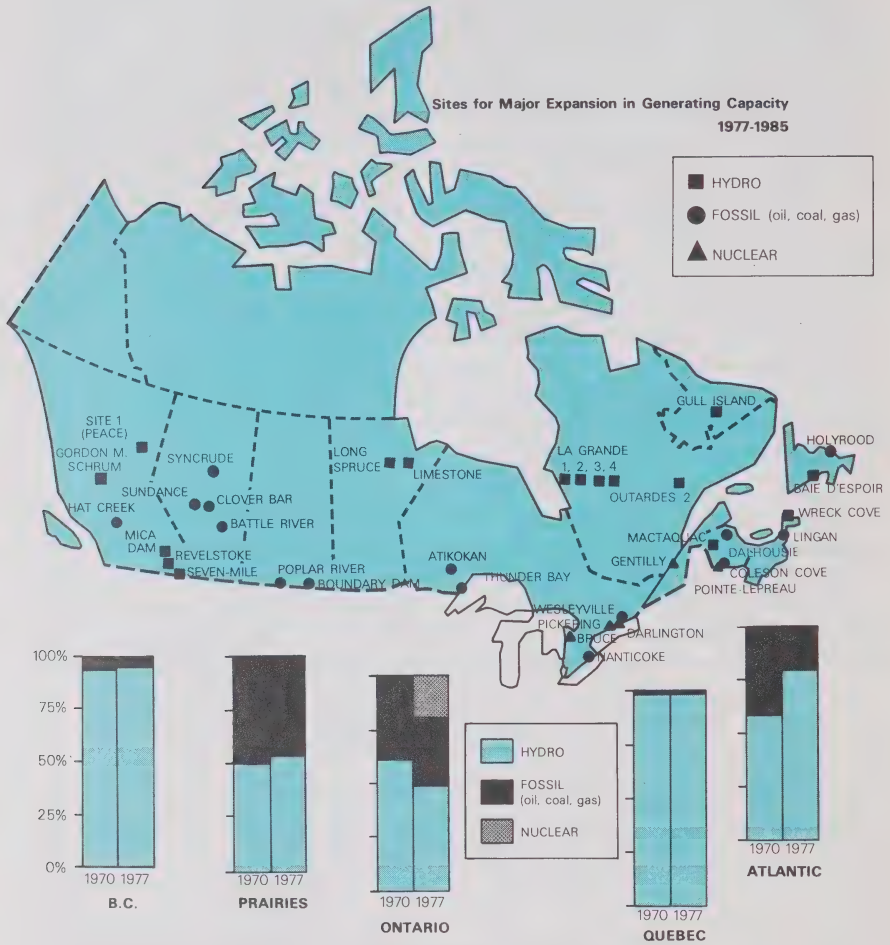
Residential Lighting, Appliances, Refrigeration, Cooking, Water Heating
(first 1 000 kWh/month)

City	1976 ^a (dollars)	1977 ^a (dollars)
Vancouver	24.98	28.65
Edmonton	20.55	20.55
Regina	21.44	25.96
Winnipeg	19.99	23.50
Toronto	20.17	24.99
Montreal	17.60	19.05
Halifax	27.24	40.00
Saint John	24.63	30.57
St. John's	22.84	33.78
Charlottetown	46.02	56.83
Whitehorse	25.30	32.90
Yellowknife	30.59	43.51
Canada ^b	20.98	24.75

^a All prices effective July 1 except Whitehorse (January 1).

^b Estimated weighted average excluding Whitehorse and Yellowknife.

ELECTRICITY IN CANADA 1977 – 1985



CANADIAN CONSUMERS OF ELECTRICITY 1977

Some related events —

MANITOBA TRANSMISSION LINE

Agreement was reached during 1977 to provide federal loans up to \$193 million to assist the expansion of the Nelson River transmission system to an ultimate capacity of 3 400 megawatts. The initial stages of this transmission system were constructed by the federal government under provisions of the leasing agreement. The latest expansion will take place in stages and is scheduled for final completion in 1985. Federal funding by that time will total approximately \$400 million, plus accumulated interest during construction.

PORTER COMMISSION

The Porter Commission on Electric Power Planning in Ontario continued its extensive series of hearings on all aspects of long-term electrical development in the province. This study includes detailed treatment of the Ontario Hydro commitment to nuclear power. There was also a modification of the capital spending ceiling set earlier by the province. The revised ceiling will apply to Ontario Hydro in 1978.

REVELSTOKE DAM

B.C. Hydro has received permission to proceed with the construction of the Revelstoke Dam on the Columbia River. A lake will be developed stretching 80 miles to the foot of the Mica Dam and the installed capacity will be 2 700 megawatts when completed, making Revelstoke the largest hydroelectric development in the province. Estimated cost for the first four of six generating units, expected to be completed by 1984, is \$1.5 billion.

MARITIME ENERGY CORPORATION

Following a feasibility study carried out in 1977, the Minister of Energy, Mines and Resources and the Premiers of New Brunswick, Nova Scotia and Prince Edward Island agreed (early in 1978) to proceed with the necessary legal and other arrangements leading to the establishment of a Maritime Energy Corporation. This Corporation would be concerned with the means of achieving optimal expansion and operation of electric power generation in the Maritime Provinces.

P.E.I. CABLE

The \$36 million interconnection between Prince Edward Island and New Brunswick was completed and placed in service during the summer. This project is being supported by the federal

government through grants and loans totalling \$27 million. Maritime Electric Company of Charlottetown is purchasing power from the New Brunswick Power Commission. The cable will reduce P.E.I.'s dependence on small thermal plants fueled by imported oil.

LABRADOR HYDRO RESOURCES

During the year, Newfoundland commenced an assessment of the hydraulic power resources of Labrador. The first phase of the assessment, 50 per cent of the cost of which (\$500 000) was funded by the federal government, covering the Southern Labrador rivers, has been completed. The second phase, covering the balance of the Labrador hydraulic resources is expected to be carried out during 1978.

GULL ISLAND AND LOWER CHURCHILL

As of December 31, 1977, development of the Gull Island hydro project site on the Lower Churchill River remains in abeyance. The project was deferred by Newfoundland in 1976 pending the outcome of negotiations with Quebec on the provision of power from the Churchill Falls hydro development. Under the existing 1969 agreement, virtually all of the output from Churchill Falls is committed to Hydro-Quebec.

The Gull project's potential is 1 800 megawatts and related facilities would include over 1 100 circuit miles of DC transmission lines and an 11-mile tunnel and power cable under the Strait of Belle Isle to transmit the power from the central Labrador site to Newfoundland. The federal government has offered a long-term loan for 50 per cent of the capital cost of the transmission facilities to a maximum of \$350 million, but alternative financing arrangements are under discussion.

Early in 1978, agreement in principle was reached to establish a Lower Churchill Development Corporation (LCDC). The Corporation will initially have as equity shareholders the province of Newfoundland and Labrador and the Government of Canada. Its primary objective will be to establish a basis for the development of the hydroelectric potential of Labrador with the first emphasis being on the Gull Island project, downstream from the existing Churchill Falls generating station.

CANADIAN ELECTRICAL ASSOCIATION

The federal government contributed \$1 million to a continuing research and development program undertaken jointly by Canadian electric utilities through the Canadian Electrical Association.

COAL

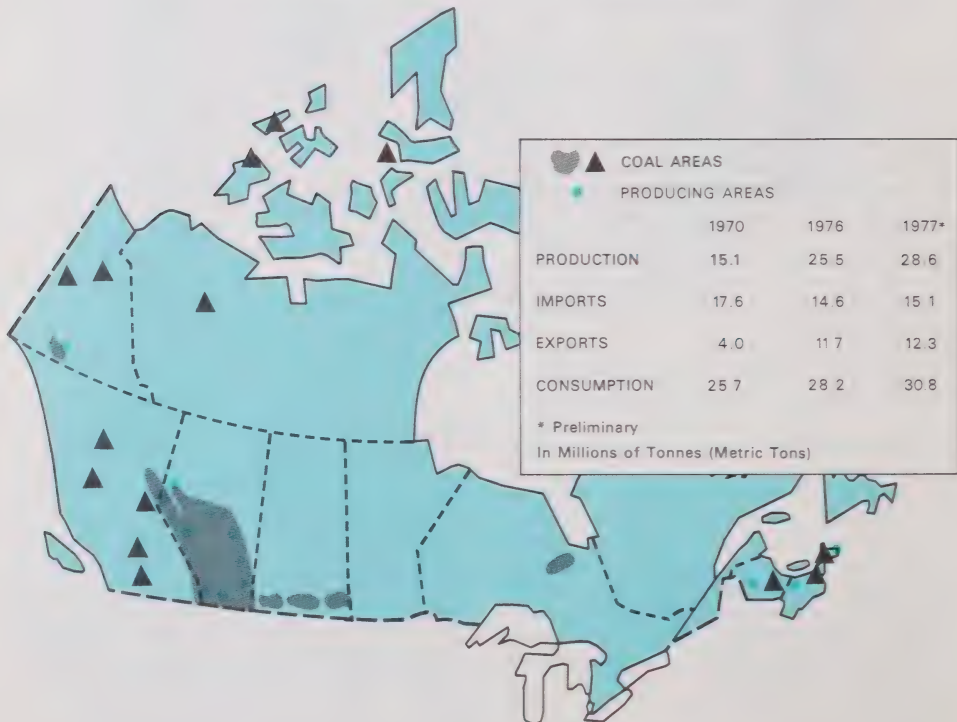
The year 1977 was characterized by increased coal production and consumption, a high level of activity in the thermal coal sector, and increased interest in coal-conversion research.

Canadian coal production rose to approximately 28.6 million tonnes, an increase of about 3 million tonnes. Consumption rose by approximately the same amount, from more than 28 million tonnes in 1976 to about 31 million tonnes in the past year.

Bituminous coal production in Nova Scotia, New Brunswick, Alberta and British Columbia reached 15.2 million tonnes in 1977, up 0.8 million tonnes. Sub-bituminous production, all from Alberta, increased by 1.5 million tonnes to 7.9 million tonnes and lignite production in Saskatchewan reached 5.5 million tonnes in 1977.

The major domestic market for coal was for electrical generation, with 1977 consumption estimated at 22.4 million tonnes, up about 3.5 million tonnes over the previous year. There was a decrease in consumption in coking coal from 7.4 million tonnes in 1976 to 6.7 million tonnes. Consumption of coal for general industrial, commercial and other uses was estimated at 1.7 million tonnes.

COAL IMPORTS AND EXPORTS



Imports of United States bituminous coal were 15.1 million tonnes in 1977, up 0.8 million tonnes. Approximately 12.3 million tonnes of coal was exported; 86 per cent of that total was coking coal destined for Japan and the remainder was bought by another eleven consumers.

In 1977, fifty mines in five provinces and the Yukon Territory reported production with thirteen producing more than 500 000 tonnes each. Six mines alone accounted for over 50 per cent of total Canadian production of raw coal. Twenty-nine coal mines were located in Alberta.

Some related events —

NATIONAL COAL POLICY

Work continued during 1977 on the development of a national policy on coal. A draft Preliminary Statement on a Canadian Coal Policy was discussed at the Energy Ministers' Conference held in Ottawa in December, and more consultations are planned for 1978.

THUNDER BAY TERMINAL

Construction of the Thunder Bay coal terminal continued during 1977. A new development in 1977 was the decision to add a \$1 million, 6 000-foot conveyor system to transfer Saskatchewan lignite from the terminal directly to Ontario Hydro's nearby Mission Island generating station. Thunder Bay Terminals Ltd. announced it now expects to start receiving rail shipments of western Canadian coal for Ontario Hydro in July 1978. In addition to one million tonnes per year of lignite for use at the adjacent generating station, two million tonnes of coal will come from the Luscar-Sterco operations in Alberta, and 600 000 tonnes from the Byron Creek Collieries in British Columbia. Outgoing capacity of the terminal — not counting the lignite — will be three million tonnes per year. This could be increased to six million tonnes.

NOVA SCOTIA PROGRAM

The government of Nova Scotia announced a program that will encourage provincial production and consumption of coal. The main points of the program include: (1) development of new coal-fired thermal electric capacity at Lingan and in the Halifax area; (2) proposed development of a new open-pit coal mine in Pictou County; and (3) an increased exploration program for new mine sites.

The proposed open-pit mine would be developed by George Wimpey Canada Limited. Money would be set aside during the first few years of production for reclamation. The province will also evaluate other prospects for open-pit mining in the Springhill region.

DRILLING PROGRAM

The federal and Nova Scotia governments agreed to spend up to \$7.5 million for onshore and offshore coal exploration. Major objective of the program is to confirm new coal resources off Sydney, Cape Breton. This is one phase in the province's recently announced plan to encourage expanded coal production. The original agreement called for the drilling of up to twelve offshore holes. Six were drilled during the 1977 season; the results, still being assessed at year's end, were generally encouraging.

NORTHEASTERN BRITISH COLUMBIA COAL

A federal-provincial agreement provided for the expenditure of \$10 million for the evaluation of geological, environmental, manpower, transportation and townsites factors related to the possible development of coal deposits northeast of Prince George, British Columbia.

BRITISH COLUMBIA COAL POLICY

British Columbia's new coal policy, announced in mid-1977, outlined a licence system that incorporates competitive bidding; committed B.C.'s coal resources to development that is consistent with other provincial objectives; retained the existing royalty of \$1.36 a tonne; tied the province's export coal prices to world prices; declared the fol-

lowing priorities for B.C. coal supply — (1) provincial needs, (2) other Canadian needs, (3) foreign needs.

COAL IN SASKATCHEWAN

Work continued during 1977 on a new coal mine and power station in Saskat-

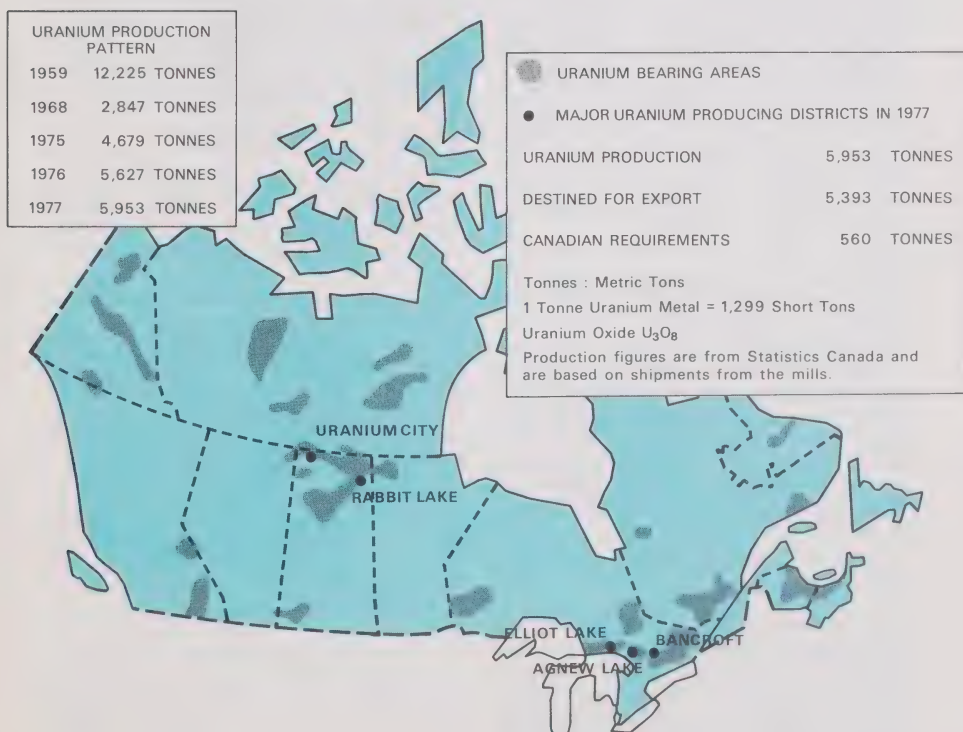
chewan. A \$30 million contract was awarded for the erection of a 90-cubic-yard dragline at the new mine near Coronach, south of Moose Jaw; the dragline will be operational in 1978. The 300 megawatt Poplar River coal-fired generating station is expected to come on stream in 1979.

URANIUM AND NUCLEAR POWER

In 1977 Canada had six uranium producing mines, four in Ontario and two in northern Saskatchewan. Five underground and one pit mine shipped 5 953 tonnes of uranium of which 5 393 tonnes were destined to serve Canada's export markets primarily in Japan, Western Europe and the United States.

Gulf Minerals Canada Limited's open-pit operation at Rabbit Lake, Saskatchewan, operated at full capacity of 1 500 tonnes of ore per day during 1977. Madawaska Mines Limited which had rehabilitated the Faraday Mine at Bancroft, Ontario, in 1976 gradually increased its production level throughout the year and was expected to reach full capacity of 1 360 tonnes of ore per day in 1978. Both Denison Mines Limited and Rio Algom Limited were expanding their mining and milling facilities at Elliot Lake, Ontario, to meet existing and forecast sales commitments. Agnew Lake Mines Limited began production in June at its underground, in situ mining leaching operation, about 90 kilometres east of Elliot Lake. Eldorado Nuclear Limited was expanding its mine and mill near Uranium City, Saskatchewan, to increase its production to a level of some 690 tonnes of uranium per year by 1979.

URANIUM PRODUCTION, 1977



Only an estimated 9 per cent of Canada's 1977 uranium output was required for the domestic nuclear power program; these needs will grow, however, to about 20 per cent of Canada's projected output in 1985. The federal government requires that sufficient uranium be reserved for domestic use to enable nuclear reactors, now operating or planned for operation 10 years hence, to operate at an 80 per cent capacity for 30 years. In addition, utilities are required to maintain contracts for 15-year's supply of uranium for both operating and committed reactors.

Based on Canada's currently known uranium resources, Canadian uranium production could grow to a level of 12 500 tonnes by 1985. Production levels beyond this however, will be dependent largely in the discovery of new deposits. Canada currently accounts for approximately 20 per cent of world uranium output.

Some related events —

NUCLEAR ELECTRICITY IN ONTARIO

Nuclear power now makes up 20 per cent of Ontario's electrical generating capacity.

The 2 000 megawatt Pickering nuclear plant continued its excellent operating history in 1977 with an average power production throughout the year of 90.7 per cent of capacity.

Two of the 750 megawatt Bruce A nuclear units were commissioned in 1977 and the third was operated up to full power. Their operational records were also excellent with average capacity factors of 84.4 per cent for the year (including steam output).

NUCLEAR ELECTRICITY IN QUEBEC AND NEW BRUNSWICK

Construction of nuclear power plants at Gentilly II Quebec and at Pt. Lepreau, New Brunswick, continued through 1977. These 600 megawatt plants are expected to be in service in 1980 and 1981. The federal government has made loans to Quebec and New Brunswick utilities to assist in the construction of these plants.

NUCLEAR CONTROL AND ADMINISTRATION BILL

In November, the Minister of Energy, Mines and Resources tabled the Nuclear Control and Administration Bill in the House of Commons. The proposed Act, which is intended to replace the Atomic Energy Control Act, now more than 30 years old, would separate responsibilities for health, safety, security and envi-

ronmental matters from those dealing with the commercial and promotional aspects of nuclear energy. The former responsibilities would be administered by the Atomic Energy Control Board (AECB) to be renamed the Nuclear Control Board (NCB), which would report to Parliament through the Minister of State for Science and Technology. The Minister of EMR would retain responsibility for commercial and promotional matters.

STRONGER SAFEGUARDS

In January the federal government embargoed the export of Canadian nuclear materials and technology to all countries which had not entered into agreements on tighter regulations regarding nuclear safeguards.

Shipments of Canadian uranium to a number of countries were affected, principally Japan, countries of the European Economic Community, Switzerland and the United States. An interim agreement with the United States was reached in November, and negotiations had been successfully completed with the EEC at year-end. Agreements had been reached earlier with Argentina, Finland, Romania, South Korea, Spain and Sweden, although in the case of Argentina and Spain only the 1974 requirements have been met; since neither country is a signatory to the *Non-Proliferation Treaty*, an additional agreement would be required to cover any new export contracts. At year-end, agreements were outstanding with Japan and Switzerland, although negotiations with Japan were expected to be concluded early in 1978.

NUCLEAR WASTE

Good prospects exist for the safe, permanent disposal of nuclear reactor wastes, and the problem of waste disposal should not delay Canada's nuclear power program, provided research and development work is begun immediately on a national disposal plan, in the judgment of an independent panel of experts commissioned by EMR. The panel, headed by Dr. Kenneth Hare, released its report in November.

RADIATION STUDIES

The Atomic Energy Control Board continued to investigate locations showing radiation readings higher than background (naturally occurring) levels in Port Hope, Ottawa, Toronto and Elliot Lake, Ont., Uranium City, Sask., and other communities. Waste, mostly from uranium mines, processing plants and research facilities, was the source in some instances. A major cause in Elliot Lake was the bed of uraniferous conglomerate which occurred naturally in the rock running through the centre of the town. Waste was removed from Port Hope, Ottawa and Toronto to other locations for storage.

The Department of Health and Welfare also conducted surveys in several areas to determine the occurrence of radon — a gas emitted naturally during the long disintegration of radioactive substances. In some instances, levels were higher than accepted under recently established federal guidelines.

NEW URANIUM PRODUCER

Canada's sixth uranium producer, Agnew Lake Mines Limited, commenced operations in June. The project employs an in situ mining-leaching technique whereby broken ore is "percolation-leached" in the stopes and the uranium-bearing solutions brought to the surface for treatment by ion-exchange. An output of some 380 tonnes of uranium per year is expected by mid-1978.

KEY LAKE RESERVES

Uranerz Exploration and Mining Limited announced new reserve figures for the Gaertner and Deilmann deposits in northern Saskatchewan, which it is evaluating jointly with the Saskatchewan Mining Development Corporation (SMDC) and Inexco Mining Company

(Canada) Ltd. Together, the two deposits contain a reported 39 471 tonnes of uranium, as well as 33 635 tonnes of nickel. Development plans will be clarified following the results of the Bayda inquiry into the uranium industry in Saskatchewan.

NEW URANIUM FINDS

Three new potential uranium prospects were reported in 1977, all associated with the edge of the Athabasca Basin in northern Saskatchewan. In another joint Uranerz/Inexco/SMDC project, a uranium prospect was discovered at Maurice Bay, west of Uranium City. Gulf Minerals Canada Limited, in a joint venture with Noranda Exploration Company, Limited, and SMDC, has located a uranium/nickel occurrence southwest of Rabbit Lake, and Conwest Exploration Company Limited has reported a drilling success in the same general area.

EXPLORATION ACTIVITY GROWS

Preliminary results of an EMR survey of uranium exploration in Canada indicate that levels of activity increased appreciably in 1977. Total expenditures likely exceeded \$60 million, with projects being reported in all provinces, as well as in the Yukon and Northwest Territories.

FEDERAL-PROVINCIAL RECONNAISSANCE

A total of \$4.8 million was spent on Canada's uranium reconnaissance program during 1977 by the federal government and the participating provinces. Some 527 200 square kilometres were covered by airborne gamma-ray spectrometry and 251 000 square kilometres by regional geochemistry, in areas of seven provinces as well as the Yukon and Northwest Territories. Late in 1977 a new 2½-year, \$1 061 000 project was announced under the program, to cover 166 000 square kilometres of Newfoundland and Labrador.

ONTARIO HYDRO/DENISON CONTRACT

In December Denison Mines Limited and Ontario Hydro jointly announced an agreement, subject to the approval of the Ontario government, whereby Denison will provide Ontario Hydro with some 48 465 tonnes of uranium from

1980 to 2011. Prices will be determined from time to time according to a formula that takes into account the cost of production, and agreed margin and world price, and the contract provides for adjustments in the amount of uranium to be delivered if requirements should diminish. Prepayments will be made by Ontario Hydro to assist Denison with the required expansion of its operation.

URANIUM CONTRACT PRICING

In March 1977 Canadian producers were informed by the Minister of Energy, Mines and Resources of a decision taken in December 1976 that "with regard to all contracts not yet approved by the Atomic Energy Control Board, and all future contracts, the government will expect that terms of sale will provide for an annual renegotiation of price based on then existing world prices, giving consideration to such factors as term

and size of contract and any special financing arrangements."

URANIUM INQUIRIES

Further to previously announced plans to investigate the implications of expanding uranium mining in Saskatchewan, the provincial government in February appointed a three-member board under the chairmanship of Mr. Justice E. D. Bayda, to inquire into the implications of Amok Ltd.'s Cluff Lake development project. Hearings were held throughout 1977 and the board's report was awaited at year-end. The Ontario Environmental Assessment Board also held public hearings during the year to assess the environmental impact of the expansion of uranium operations in the Elliot Lake area. The recommendations of these boards could have a profound effect on the nature of future developments in the two provinces.

ENERGY RESEARCH AND DEVELOPMENT

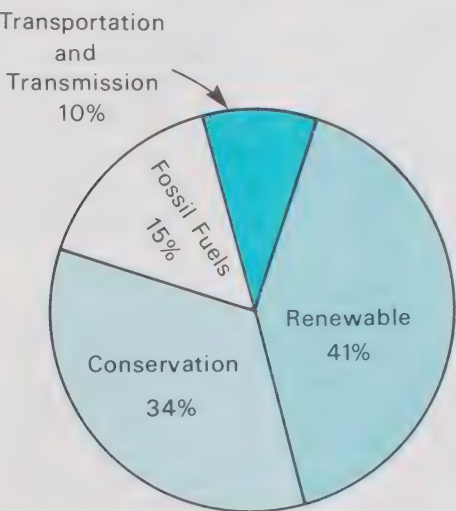
Stripped to its bare essentials, the “energy crisis” means that we must become less dependent on petroleum as a major energy source before the world’s appetite for oil overtakes the world’s ability to produce it. Some experts see this oil supply crisis occurring as soon as 1985-1990.

One of the most valuable resources we have to meet this crisis is time — time to make the change to a better balanced energy supply, one that uses as many other sources of Canadian energy as possible.

To achieve this better balance in Canada’s future energy supplies, the federal government’s energy research and development program is channelling the largest share of new R & D funds into projects on renewable energy resources; substituting more plentiful fuels for conventional oil; and finding more efficient ways of using energy. This trend is indicated in the graph below, showing how funding increased in the 1977-78 fiscal year.

Some estimates indicate that by the year 2000, solar and other alternate energy resources could contribute the equivalent of 10 per cent of the total energy used by Canadians in 1975. Federally funded research programs in solar, wind and biomass energy are a first step in making that contribution possible. Approximately one third of the total federal energy R & D budget of \$130 million in 1977-78 is being spent in the private sector.

INCREASES IN FEDERAL RESEARCH AND DEVELOPMENT FUNDS



\$10 Million

1977 - 78

Some related events —

INCREASED R & D FUNDING

Energy Minister Alastair Gillespie announced in October an increase of \$15 million in supplementary funding for federal energy research and development for 1978-79. This brings the projected federal expenditure in energy R & D for that fiscal year to \$145 million. Of the additional funds, \$6.3 million is earmarked for R & D on renewable energy resources, and the largest portion of that amount — \$3.9 million — goes towards utilization of solar energy. This will bring total federal funding on solar research and development since 1976 to \$7.6 million. An amount of \$1.55 million will be used in biomass research, chiefly to assess and demonstrate the potential of wood and mill wastes as a substitute for conventional fuels.

Energy conservation is allocated \$5.6 million, and \$750 000 is directed towards the utilization of hydrogen as part of the Canadian energy supply system. Other areas to benefit from the new funding are fossil fuels (\$1.4 million), and energy transportation and transmission (\$1.25 million).

FUEL FROM BIOMASS

The federal government in 1977 awarded a \$220 000 contract to Inter-group Consultants of Winnipeg to study all aspects of the production of synthetic fuels from forest biomass resources. The study is being conducted under the supervision of the Departments of Energy, Mines and Resources and Fisheries and the Environment, which funded the project.

P.E.I. RENEWABLE ENERGY PROGRAM

The federal/provincial program for renewable energy studies in Prince Edward Island, initiated in 1976, continued through 1977. Elements of the program include studies on wood as an energy source, wind-power potential, solar heating, and reduction in energy demand. The Island's potential for hydroelectric power generation is being reassessed, and the development of a low-energy community concept is being supported in co-operation with the P.E.I. Housing Corporation. The Ark, an experimental bioshelter that uses solar energy, wind and wood power, a greenhouse and fish-

pond to sustain its inhabitants, are also supported.

Federal funding for the renewable energy program is \$3 million — \$1 million per year over a three-year period. It is managed and co-ordinated by P.E.I.'s Institute of Man and Resources.

MAGDALEN WINDMILL

A 230-kilowatt, wind-powered turbine was erected on Magdalen Islands in May 1977, and went into operation in July. By year's end it was operating at up to 80 per cent of maximum speed, producing roughly 50 per cent of maximum power output. The prototype windmill, with an aluminum rotor 120 feet high and 80 feet in diameter, is a joint project of Hydro Quebec and the National Research Council.

SOLAR HOMES DOUBLE

The Solar Energy Society of Canada estimated that, by the end of 1977, close to 100 Canadian homes were being heated by solar energy. This is roughly double the number for 1976.

INTERNATIONAL ENERGY RESEARCH PROGRAM EXPANDED

Canada further expanded its international energy research program during 1977, signing agreements with other member countries of the International Energy Agency to participate in research projects on coal, hydrogen, wind and nuclear fusion. This brought to ten the number of IEA energy research projects in which Canada is involved.

ALBERTA RESEARCH

The Alberta/Canada Energy Resources Research Fund, in its second year of operation, had an estimated budget of \$4 million. Research conducted under the program included projects in coal-mining and in situ gasification; uses of solar energy, wind energy and waste wood; and enhanced recovery of conventional crude oil.

COAL CONVERSION R & D

Funding commenced early in 1977 for a joint research and development program between the federal government, private industry and public utilities to

substitute coal for oil and natural gas. The studies cover gasification and liquefaction of coal, and new methods of burning coal. Seventeen projects have been approved under the 50-50 shared program, with federal funding to the end of the 1977-78 fiscal year totalling \$1.47 million. Plans for 1978-79 include 100 per cent funding for coal conversion studies by smaller organizations such as universities which have no research funds.

NEW NRC GRANTS PROGRAM

Energy research in Canada received an additional stimulant in July, when the National Research Council announced a new program of strategic grants to university researchers, to "initiate or ac-

celerate substantial programs of research" in designated areas of national concern. Energy is one of three initially designated areas. Funding for 1977-78 was set at \$1.1 million.

ENERGY R & D INVENTORY

The Department of Energy, Mines and Resources in 1977 published the first annual *Inventory of Energy Research and Development Supported by the Government of Canada*, which lists, with substantial detail, all energy R & D activities funded by the federal government during the fiscal year 1976-77. The publication — Report ER 77-3 — includes an appendix containing background and supplementary information on the expansion of energy R & D during 1977-78.

BIBLIOGRAPHY

A number of energy and energy-related publications are available to the general public, either free of charge from the Department of Energy, Mines and Resources, or at a nominal charge from the Government Publishing Centre, Ottawa K1A 0S9. Some titles are listed below.

An Energy Strategy for Canada: Policies for Self-Reliance (Summary). (1976, 32 pages) (No charge).

An Energy Strategy for Canada: Policies for Self-Reliance. (1976, 170 pages) (Canada: \$2.50; other countries: \$3.00).

Keeping the heat in — How to re-insulate your home to save energy and money. (1976, 112 pages) (Office of Energy Conservation) (No charge).

The car mileage book. (1977, 106 pages) (Office of Energy Conservation) (No charge).

Energy: The Task Ahead — Policy Questions and Answers. (1977, 48 pages) (No charge).

Renewable Energy Resources — A Guide to the Literature. (1978, 32 pages) (No charge).

Renewable Energy Resources — A Guide to the Bureaucracy. (1978, 18 pages) (No charge).

For further information about energy publications, write to:

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